3M Company
St. Paul, Minnesota

Environmental Assessment for Perfluorochemicals (PFCs) Summary Report

3M Cordova, Illinois Facility

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Table of Contents

Figures

Appendices

3M Cordova, Illinois
1610150001 – Rock Island County
22614 IL Highway 84 North, Cordova, IL
Environmental Assessment for Perfluorochemicals (PFCs)

Executive Summary

The 3M Cordova manufacturing facility was originally constructed in 1970 and continues to produce numerous chemical products. These include adhesives, resins, fluorochemicals and other specialty chemicals. The Site exists in a rural setting and is located at 22614 Highway 84 North, approximately one mile north of Cordova, Illinois, in northwestern Rock Island County. The facility consists of a 739-acre plot with manufacturing operations taking place on a 100-acre triangular portion that is bordered by a Burlington Northern Santa Fe Railroad line and Highway 84 to the east, the Mississippi River to the west and other industrial properties to the north and south.

The Site has undergone previous environmental assessments, including a RCRA Facility Assessment (RFA) that was completed in a 1996-98 timeframe. However, more recently, an environmental assessment (Assessment) has been conducted for perfluorochemicals (PFCs) including perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), perfluorobutanoic acid (PFBA), perfluorohexane sulfonate (PFHS) and perfluorobutane sulfonate (PFBS). This work commenced in August 2006 when 3M voluntarily sampled the on-site facility production wells and continued in a phased approach through 2013. The investigation has been conducted with the oversight and approval of the Illinois Environmental Protection Agency (IL EPA) through the Site Remediation Program.

This report summarizes the extensive data generated and previously submitted to the IL EPA – 10 reports and work plans over 6+ years (collectively "PFC Assessment"). These data provide a basis for IL EPA's review and approval of the proposal to establish a Groundwater Monitoring Zone (GMZ), in accordance with the agency's rules and guidance, including monitoring and reporting.

The PFC Assessment was conducted to evaluate the potential presence of PFCs in environmental media associated with current and former manufacturing operations at the Site. Of particular interest were: 1) the production areas of the Site, 2) on-site former agricultural land where Site wastewater treatment sludge had been incorporated pursuant to an NPDES permit as an agricultural amendment , and 3) the impact of significant groundwater extraction by the Site's well field. In the course of this study, groundwater, surface water and pore water were assessed off-site while groundwater and soils were evaluated on-site. In addition, groundwater elevation measurements were taken on multiple occasions to document groundwater flow directions in and around the Site.

In the course of this Assessment, site-specific remediation objectives were established by the IL EPA for several exposure pathways for PFOS, PFOA and PFBA. Insufficient information was available to derive values for the other two constituents that have been part of this work (PFHS and PFBS). Analytical data generated as part of the Assessment indicates that multiple on-site locations do not meet one or more of the remediation objectives. However, the work has also established that:

- The impacted on-site soils are below all site-specific objectives for direct ingestion except for PFOS where less than 2% of the results were above the residential exposure criterion (not applicable to this controlled-access industrial site).

- Impacted groundwater above site-specific objectives has only been measured in on-site wells and this water is not used for drinking water purposes. Furthermore, this water is contained or "captured" by an existing network of production wells that supply process water for ongoing operations at the Site. Following use, waters are discharged under a National Pollutant Discharge Elimination System (NPDES) permit that includes PFC monitoring and reporting conditions.
- Off-site groundwater is well below guidance criteria developed by IL EPA.
- Site conditions are generally stable (ex, flow and capture of on-site groundwater).

Based on direction from the IL EPA, the practicality and benefits of possible remediation approaches have been considered in light of the levels and distribution of PFCs documented at the Site. In summary, an extensive characterization of Site conditions has been conducted, no exposure pathways of concern have been identified, there are no practical or feasible cleanup techniques that would result in meaningful reductions in releases to the environment, and the creation of a Groundwater Management Zone is proposed as an effective and appropriate remedial action.

Facility Information and Background

1. General description

   a. Site location and description

   The 3M Cordova facility is located at 22614 Highway 84 North, approximately one mile north of Cordova, Illinois, in northwestern Rock Island County. The facility consists of a 739-acre plot with manufacturing operations taking place on a 100-acre triangular portion that is bordered by a Burlington Northern Santa Fe Railroad line and Highway 84 to the east, the Mississippi River to the west and other industrial properties to the north and south.

   b. Products manufactured

   The Site was originally constructed in 1970 and throughout much of its history consisted of two significant, but very different, manufacturing operations:

   Specialty Chemicals – The 3M organization that makes these products is currently known as the Materials Resource Division (MRD). In the past, this operation has been identified as the "Chemical Division" or the "Specialty Materials Division". It is sometimes simply referred to as the "Chem. Plant". This facility produces a variety of products including adhesives, resins, fluorochemicals and other specialty chemicals. The primary SIC codes for this operation are 2899, 2891, 2851, 2821 and 2816.

   Magnetic Media – The 3M organization that last made these products at the Site was known as the Specialty Media Products Division. In the past, this operation was also identified as the "Magnetic Audio/Visual" or "Magnetic Media" division. It is sometimes simply referred to as the "Mag. Plant". This facility was constructed in 1973, closed in 2004 and decommissioned in 2005. While operating, the plant manufactured magnetic iron oxide that was used for the production of audio and video recording tapes. This operation was located in the northern part of the developed portion of the 3M Cordova facility.

   To elaborate on current manufacturing at the Site, it can be divided between two general activities or types of products: Internals and Electronic Materials. For the most part, products manufactured in the Internals factory are utilized at other 3M facilities in the manufacture of various industrial, commercial and consumer products. Products include acrylate monomers, acrylate adhesives, solid and liquid epoxy resins, and low adhesive coating solutions. Manufacturing is largely conducted in flexible batch processing equipment which can be configured to produce the variable processing conditions that are required for the diverse materials being made. Raw materials, intermediates, and final products are transported in various sized containers including drums, totes and containers. There are also a number of tank areas located adjacent to the manufacturing buildings that are used for the bulk storage of materials.

   The Electronics Factory produces a variety of specialty fluorinated materials such as heat transfer fluids, fire suppressants and materials that are used in semi-conductor applications. The manufacturing configurations have some similarities with the Internals Factory. Hydrofluoric acid and various organic precursors are combined in an electrochemical fluorination process to produce intermediates that are further distilled

and purified in various downstream processes. Raw materials, intermediates and final products may be stored in tanks that are largely contained within the process buildings. Final products consisting of various fluorinated gases may also be stored in pressurized shipping containers that are located adjacent to the manufacturing facilities.

c. Water supply

A high capacity, alluvial well field is located on the undeveloped portion of the site east of Highway 84 and supplies the facility with process and non-contact cooling water. This water is not used as a drinking water supply for the Site. For many years, this system consisted of five groundwater productions wells (Nos. 11, 12, 13, 24 and 37) that ranged in depths from 168 to 179 ft below ground surface (bgs). More recently, three additional wells have been added to the system and one well as been closed.

In January 1998, 3M acquired an additional strip of former agricultural land to expand its southern boundary to the east of Highway 84. This property included a well formerly used for irrigation purposes that was added to the Site production well system in 2011. The identification number for this well is now PW-94. In May 2012, 3M installed an additional new well (PW-91) in this same southern parcel. Finally, in January 2013, PW-12 was abandoned due to diminished capacity and replaced in virtually the same location by a new well, PW-112. In similar fashion, and for identical reasons, PW-13 will be abandoned in 2014 and replaced in essentially the same location by a new well, PW-113.

The Site's well field has been designed to meet a plant water demand of 10-12 million gallons per day (gpd). Based on plant records for 2013, the average flow rates for the plant production wells ranged between 514 gpm (PW-13) and 1950 gpm (PW-112). The total annualized system flow rate was 5540 gpm (approximately 8.0 mgd). In 2013, the production well network extracted approximately 2.9 billion gallons of groundwater for plant use.

Provided in Appendix A is additional information on the Site production wells including a summary table of facts and the well logs.

d. Wastewater treatment, including sludge management

The 3M Cordova facility has operated its own wastewater treatment plant (WWTP) since startup of the site in 1970. These facilities are located along the western edge of the manufacturing area and are used to treat all process and sanitary wastewaters at the plant. Treated wastewater from the WWTP is discharged to the Mississippi River via a submerged diffuser and is governed by National Pollutant Discharge Elimination System (NPDES) Permit No. IL0003140.

In 2013, the Site NPDES permit was renewed. At 3M's suggestion, monitoring under the program was expanded to include several PFCs including perfluorobutanoic acid (PFBA), perfluoropentanoic acid (PFPeA), perfluorohexanoic acid (PFHxA), perfluoroheptanoic acid (PFHpA), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), perfluorodecanoic acid (PFDA), perfluoroundecanoic acid (PFUnA), perfluorododecanoic acid (PFDoA), perfluorotridecanoic acid (PFTrA), perfluorobutane sulfonate (PFBS), perfluorohexane sulfonate (PFHS), perfluorooctane sulfonate (PFOS) and perfluorooctane sulfonamide (FOSA). Results for these constituents are now generated and reported under the NPDES program on a quarterly basis.

On-site management of WWTP sludge, and specifically the practice of land incorporation of sludge from 1975 to 1999 (see below), was one of the primary reasons for commissioning a PFC environmental assessment at the 3M Cordova facility.

In the early 1970's, prior to land incorporation, sludge from the WWTP was solidified using a "chem-fix" process. The "chem-fix" process involved solidification of the sludge by adding a clay/lime mixture to the waste. The mixing of the sludge occurred approximately in the area of the present Building 20, and west and south of that structure. The stabilized sludge was disposed on site in an excavated area. This process and on-site disposal was permitted by IL EPA (Permit 1973-63-OP and 1974-89-OP).

From 1975 to 1999, sludge generated from the organic and inorganic treatment processes at the Site WWTP was land incorporated on agricultural fields that are part of the 3M Cordova property. This program began in 1975 after a permit was received from the IL EPA allowing incorporation of one million gallons of aerobic digester sludge annually on 115 acres. A supplemental permit was granted in May 1976 to increase the volume of sludge to 3.3 million gallons annually (including 800,000 gallons of magnetic oxide sludge) and to expand the incorporation area to 371 acres. This permit was renewed in July 1978 and was continually renewed or amended by 3M until sludge incorporation was discontinued at the end of December 1999.

Sludge that was land-applied was typically spread on the field surface and then incorporated with a disc. Spreading rates averaged about 8,000 gallons per acre per year and were based on agronomic requirements (i.e., nitrogen content). Sludge was not applied in the winter when the ground was frozen, during periods of rainfall or on ground with standing water. Monitoring of soil, groundwater and crops was performed to meet permit requirements, generally pertaining to metals application rates. The last sludge application was in December 1999 and the permit governing this activity expired in June 2000.

A detailed summary of the gallons of sludge applied on the various defined fields or zones has been previously submitted to the IL EPA and is not repeated in this document. Based on available information, Zones 1 through Zone 9 were used throughout the history of sludge application at Cordova. Application rates were based on agronomic calculations and on the permit limitations for specific metals. Zone 10 was only used in 1993 and one other time in 1998. Zone 11 was never used for sludge incorporation. Zone 12 was added in the spring of 1994. A "control" zone was centrally located at the west end of Zone 9 but was separated from the sludge incorporation activities by a ditch and a road. Sludge was never incorporated in the control zone.

From year 2000 to present, sludge has been periodically dewatered by an outside contractor and disposed in offsite landfills. Presently sludge is sent to the Upper Rock Island County Landfill in East Moline, IL. Prior to shipping sludge to this landfill, sludge had been sent to the Peoria Disposal Company #1, Peoria, IL and Orchard Hills Landfill, Davis Junction, IL.

3M WWTP sludge was only land-applied to property owned by 3M. At the time, these areas were actively used for growing agricultural crops. No rental of these fields for agricultural purposes has taken place for over a decade and 3M has maintained these areas as "green space" under its own control.

e. Map of area, including all utilities and structures

Included as Figure 1 is a USGS topographical map showing the location of the facility. The Site layout showing details of the manufacturing areas at the facility is provided on Figure 2. Also included as Figure 3 is a map illustrating the zones that made up the sludge incorporation area (SIA) and the locations of the Site production wells.

2. Waste units / potential source areas present at the Site

Relative to the current PFC environmental assessment for the Cordova site, there are fundamentally two potential source areas. (It should be noted that a RCRA Facility Investigation (RFI) and other environmental assessments (i.e., focused investigation on railcar unloading station) for conventional constituents have previously been completed for the Site but are not relevant to the study at-hand.)

The first area is the Materials Resource Division's production plant where historical releases of PFCs may have occurred. These might have included spills from containers or piping systems, leaks from sewers or wastewater treatment units, etc. There are no known ongoing releases in this area of the facility.

The second potential source area for this PFC assessment is the former sludge incorporation area (SIA). A description and history of this operation is provided above. In terms of status, no sludge has been applied since 1999 and the former incorporation areas are now managed as green space.

3. Description of topography, geology and hydrogeology

a. Topography/Drainage

The Cordova facility is located adjacent to the Mississippi River in the northern portion of Rock Island County. The site topography is generally flat with a high elevation of 630 feet, east of Highway 84, near the production wells, to 588 feet at the plant manufacturing area. Natural mounding and river front road maintenance have raised the levee area near the river above typical flood elevation.

Locally, surface drainage is generally from east to west with culverts and road ditches directing most precipitation runoff from the surrounding agricultural area to the river. The U.S. Army Corps of estimates that the Mississippi River 100-year crest at Cordova is at 588.5 feet and the 200-year crest is at 589.5 feet.

Storm water runoff from the site production area drains to an on-site storm sewer that ultimately discharges to the Mississippi River, west of the facility. The storm water discharge from the site is permitted under IL EPA NPDES permit number IL0003140. There are four storm water retention swales located on the property, each associated with a river outfall.

Storm water from the sludge incorporation area (SIA) generally infiltrates vertically through the sandy soils to the water table. The area is mostly flat, vegetated and there is no active management of storm water.

b. Geology

Rock Island County and the 3M Cordova facility are located at the northwestern edge of the Illinois Basin. Silurian dolomites sub crop below the 60-feet to greater than 100-feet thick alluvium cover at the facility. These same dolomites outcrop further south toward Port Byron and further north toward Savanna at the Mississippi Palisades north of the Plum River fault and the Savanna anticline.

The facility is located north of the Rock River confluence with the Mississippi River on alluvial terrace deposits in the northwestern extreme of the Illinois Till Plain. Desiccation, meandering, and alluvial deposition along the Mississippi and Rock Rivers have formed an alluvial landscape locally with wave-formed terraces and alluvial valleys. The Cordova site is bounded on the east by the steep slope of a former channel of the Mississippi River. Alluvium depth averages over 50 feet at the facility based on data from 3M well records and original Layne-Western Company Cordova Industrial Park reports.

c. Soils

The United States Department of Agriculture (USDA), Soil Conservation Service (SCS), General Soil Map for Rock Island County indicates that the 3M facility is situated in the Sparta-Dickinson-Coyne (35 % – 15 % – 15 %) association. These soils are well drained to excessively drained, and mainly formed in sandy materials on terraces. The remaining 35 % of soils are minor occurrences.

Sparta soils consist of very dark, grayish-brown sand to a depth of about 28 inches and a subsoil of dark yellowish brown sand about 8 inches thick. The underlying material is yellowish-brown loose sand.

Dickinson soils consist of a dark grayish-brown sandy loam about 13 inches thick and a subsoil layer about 22 inches thick consisting of dark-brown sandy loam and dark yellowish-brown loamy sand. The underlying material is yellowish-brown loose sand.

Coyne soils consist of a 5-inch layer of very dark gray fine sandy loam, a 14-inch layer of brown fine sandy loam, and a 13-inch layer of reddish-brown silty clay loam. The underlying material is brown to dark-brown sand and fine gravel.

The general soil profile, as identified from borings west of Illinois Highway 84, consists of 1 to 3.5 feet of topsoil underlain by 2 feet of loose sandy silt and a one foot layer of clayey silt. Below this clayey silt layer is loose fine coarse sand to 10 feet in depth and medium dense sands to 50 feet in depth. The general soil profile, as identified from soil boring east of Illinois Highway 84, consists of 1 to 2.5 feet of topsoil underlain by loose sand to fine gravel to a depth of 15 feet. Below this sand and gravel layer is medium dense sand to 50 feet in depth.

d. Hydrogeology

Potable water aquifers in the vicinity of the 3M site include alluvial sand and gravel deposits (20 to 180 feet deep) generally used for agricultural irrigation and residential

use; creviced, Niagara series (Silurian) dolomites, clays and siltstones (20 to 400 feet deep) for low volume residential and agricultural use; and deep (400 to 1,600 feet deep) Ordovician and Cambrian dolomites, shales and sandstones used primarily for municipal, utility and industrial needs. The seven production wells at the 3M Cordova facility withdraw water from alluvial deposits in a buried, former channel of the Mississippi River at depths ranging from 117 to 183 feet bgs. Regionally, groundwater flows from areas of topographic highs towards the west/northwest in the vicinity of the site, and discharges to the Mississippi River.

The groundwater flow direction at the site has been investigated on numerous occasions as part of various groundwater monitoring programs. As illustrated on Figure 4, numerous monitoring wells have been installed over time at the Site that enable multiple depth-to-groundwater readings and ultimately the construction of groundwater contour maps. Furthermore, as part of the recent PFC assessment work, six piezometers were installed in April/May 2013 as indicated on Figure 4 to add refinement and detail to the contour maps.

Data has been collected to evaluate groundwater flow direction at the 3M Cordova site in August 1990, June 1992, February 1993, October 2006, March 2008, August 2008, December 2009, August 2012, February 2013, June 2013 and November 2013. Results from each of these campaigns have been summarized in Appendix B.

For nine of the eleven evaluations referenced above, the general direction of groundwater flow beneath the facility is primarily from the Mississippi River east toward the production wells located along the eastern property boundary. With the recent addition of wells PW-91 and PW-94, capture of groundwater along the southern boundary has also been enhanced. With a few exceptions, the groundwater elevations collected from monitor wells across the majority of the facility are lower than the normal reported pool elevation of 572 feet above mean sea level for the Mississippi River. Since this reported elevation of the River is higher than the majority of groundwater flow across the site, it correlates with the interpreted direction of groundwater flow across the site showing that the groundwater flow direction at the time of the measurements is away from the River and into the production wells. This indicates that the pumping of the site production wells locally reverses the natural gradient (toward the river) and creates a capture zone beneath the former sludge fields and production areas of the facility. Given that the Site (and therefore the well field) operates on a "24/7" schedule (i.e., continuously), consistent groundwater capture across the property is established.

For two of the eleven assessments, June 1992 and August 2008, groundwater elevations showed a groundwater divide just to the east of the main plant production area of the site. The interpreted direction of groundwater flow from this groundwater divide during these readings is westerly toward the Mississippi River, and easterly toward the site production wells. The presence of the groundwater divide appears to be a temporal condition and may relate to seasonal fluctuations driven by precipitation events and/or fluctuations in the river level.

To evaluate possible seasonal impacts and current conditions, groundwater elevation contour maps were generated for February, June and November 2013. Groundwater elevation data for June and November 2013 were supplemented with water level information obtained from the six new piezometers installed in May 2013 near the Site production wells. In addition, new production wells PW-91 and PW-94 were operating at

the time groundwater elevation data were collected in June and November 2013. PW-12 had been abandoned by the time these three datasets were collected but its replacement well, PW-112, was on-line by the time of the November 2013 data collection. Throughout 2013, the interpreted direction of groundwater flow is from the river east toward the Site production wells. The cone of depression induced by the production wells appears to be more pronounced for the June and November 2013 time periods when compared to any of the other contour maps. This is likely due to the additional groundwater elevation data points provided by the new piezometers, the additional pumping at production wells PW-91 and PW-94, and the replacement of an old and diminished capacity well (PW-12) with a new, high capacity well (PW-112).

Groundwater elevation data collected for June 2013 were much higher compared to February and November 2013. This was due to above average precipitation and the fact that the Mississippi River was at flood stage. Interestingly, the pattern of essentially complete groundwater capture across the Site was identical across the three events, even with nominal water elevation changes of five or more feet.

The Site production wells are inducing a moderate hydraulic gradient across the site from the river to the pumping wells. The calculated values are 0.0017 ft/ft, 0.0019 ft/ft and 0.0022 ft/ft for February, June and November 2013, respectively.

4. Groundwater classification

Groundwater at, and in the immediate vicinity of, the 3M Cordova facility is presumed to be Class I, Potable Resource Groundwater, as defined in Title 35: Environmental Protection, Subtitle F: Public Water Supplies, Chapter I: Pollution Control Board, Part 620: Groundwater Quality.

As previously described, 3M now uses up to seven production wells at the 3M Cordova site to provide water needed for its manufacturing operations, including non-contact cooling water. This water is not used for drinking water purposes. Furthermore, given that the facility has a steady and ongoing "24/7" production schedule, the well field is pumping significant quantities of water on essentially a continuous basis and approximates a "steady state" operation.

Given its generally rural setting, there is no public water distribution in the immediate vicinity of the plant. According to the IL EPA Source Water Assessment database, the closest wells supplying water for public distribution are in the towns of Cordova, five miles south of the plant, and Albany, four miles north of the plant. Homes, farms and businesses presumably use wells for domestic, agricultural or commercial use. Nearby wells in these categories have been sampled and results are reviewed in the Site Assessment section of this document.

5. Background to Site PFC Environmental Assessment

In May 2000, 3M announced that it was phasing out all manufacturing and use of perfluorooctanyl substances. This decision was based on the recent discovery at that time of the widespread presence of certain of these compounds in the blood of the general population and in the environment globally. The company continues to believe that PFCs such as PFOS and PFOA do not present any health risks at the levels they are typically found in the environment or in human blood. However, 3M chose to not add further to the presence of these substances and to pursue other, more sustainable, chemistries.

Two of the substances that were part of 3M's phaseout and that have garnered attention in the scientific and regulatory communities are PFOS and PFOA. The basic manufacturing process for 3M that enables production of these and related compounds is electrochemical fluorination (ECF). While ECF has been, and continues to be, a key technology for the 3M Cordova facility, production of PFOS, PFOA and/or related materials was never a significant part of the "product portfolio" for the Cordova ECF cells.

While PFOS and PFOA were not thought of as significant materials used or produced at 3M Cordova over the course of its history, 3M nevertheless decided to sample its production wells at the Site in August 2006 and conduct analyses for these constituents. PFOS results ranged from 0.2 ug/L (PW-37) to 12 ug/L (PW-13) while PFOA varied from 0.2 ug/L (PW-11) to 4.6 ug/L (PW-13). At the time, the State of Minnesota was one of the few places with drinking water criteria for these substances with Health-Based Values of 1 and 7 ug/L for PFOS and PFOA, respectively. Guided in part by the fact that some of the samples from the production wells exceeded the State of Minnesota drinking water criteria, results were communicated to plant employees, IL EPA and U.S. EPA. The few locations in the facility where water could be consumed (example, coffee machines) were shut down or converted to bottled water. The majority of the plant was already on bottled water due to the presence of nitrates in the Site groundwater and on issues with *Escherichia coli*. Based on the measured presence of PFOS and PFOA in the Site production wells, 3M determined that further environmental assessment was appropriate and approached the IL EPA about conducting such work under the Site Remediation Program. This concept was agreeable to the agency and led to the phased investigation that is described in the next section.

Information Regarding the Release (Site Assessment)

1. PFC overview including 3M phaseout of perfluorooctanyl substances

As previously noted, based on scientific information and data acquired in the late 1990's, 3M announced in May 2000 that it would be phasing out the manufacturing and use of perfluorooctanyl chemistries. The majority of this phaseout action was accomplished by the end of 2002. Two perfluorooctanyl compounds that have garnered interest are perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA). 3M Cordova had minor production of perfluorooctanyl substances by electrochemical fluorination (ECF) at the site. Manufacturing records indicate that ECF cell production of PFOS only occurred for a short time from 1989-1990 and PFOA from 1992-1993. However, trace levels of these compounds may have been present in other products and/or there could have been other processing (i.e., non-ECF manufacturing processes) of materials containing these compounds over time. For all of the above reasons, PFOS and PFOA were identified as constituents of interest for this environmental assessment.

At the time this Cordova assessment was commissioned, 3M was in the midst of PFC assessments at other locations that included both PFOS and PFOA but also perfluorohexane sulfonate (PFHS) and perfluorobutane sulfonate (PFBS). For consistency, these compounds were also proposed to be included in the Cordova study. In addition, given the possible presence of perfluorobutanoic acid (PFBA) based on manufacturing operations at the site, it too was suggested as a compound to be evaluated. These five compounds were agreed upon as constituents of interest and relevant Chemical Abstracts Service Numbers are listed as follows:

Chemical Description	Chemical Abstracts Service No.
Perfluorooctane sulfonate (PFOS)	1763-23-1 (acid) 29081-56-9 (ammonium salt) 70225-14-8 (DEA salt) 2795-39-3 (potassium salt) 29457-72-5 (lithium salt
Perfluorohexane sulfonate (PFHS)	355-46-4
Perfluorobutane sulfonate (PFBS)	375-73-5
Perfluorooctanoic acid (PFOA)	335-67-1 (acid) 3825-26-1 (ammonium salt) 335-95-5 (sodium salt) 2395-00-8 (potassium salt) 335-93-3 (silver salt)
Perfluorobutanoic acid (PFBA)	375-22-4

2. Review of site assessment activities

A site investigation has been conducted for the facility that has included on-site groundwater and soils and off-site groundwater, surface water and pore water. The analytes assessed were those listed above. In addition, groundwater elevation data has been collected and evaluated for multiple time periods.

Each step of the process has included the preparation of a work plan that has been submitted to the IL EPA for review, comments and, ultimately, approval. Following completion of each phase of work, results have been shared with the IL EPA, typically in a meeting format followed by submittal of written summary reports.

The following is a summary of the work plans and reports including brief descriptions of media evaluated:

- June 2007. *Fluorochemical (FC) Assessment Work Plan for the 3M Cordova, IL Facility.* Prepared by Weston Solutions, Inc. for the 3M Company. **Results presented**: groundwater elevation measurements (August 1990, June 1992, February 1993 and October 2006), production well PFOA and PFOS concentrations (August 2006). **Proposed additional work**: groundwater elevation measurements, on-site monitoring and production wells sampling, identification of off-site residential and commercial wells.
- June 2008. *Interim Fluorochemical (FC) Groundwater Assessment Report, 3M Cordova, Illinois.* Prepared by Weston Solutions, Inc. for the 3M Company. **Results presented**: groundwater elevation measurements (March 2008), on-site monitoring and production wells (March 2008), survey of off-site residential and commercial wells.
- March 2009. *Addendum No. 1 to the Fluorochemical (FC) Assessment Work Plan for the 3M Cordova, IL Facility.* Prepared by Weston Solutions, Inc. for the 3M Company. Results presented: groundwater elevation measurements (August 2008). **Proposed additional work**: groundwater elevation measurements, on-site monitoring and production wells sampling, off-site commercial well sampling.
- April 2010. *Fluorochemical (FC) Assessment Activities Update for the 3M Cordova, IL Facility.* Prepared by Weston Solutions, Inc. for the 3M Company. **Results presented**: groundwater elevation measurements (December 2009), on-site monitoring and production well sampling (December 2009), off-site commercial well sampling (December 2009). **Proposed additional work**: off-site residential well sampling.
- October 2010. *Addendum No. 2 to the Fluorochemical (FC) Assessment Work Plan for the 3M Cordova, IL Facility.* Prepared by Weston Solutions, Inc. for the 3M Company. **Proposed additional work**: on-site soil sampling, off-site residential well sampling.
- February 2012. *Fluorochemical (FC) Assessment Activities Update for the 3M Cordova, IL Facility.* Prepared by Weston Solutions, Inc. for the 3M Company. **Results presented**: off-site residential wells (July 2011), on-site soil sampling (March 2011). **Proposed additional work**: off-site residential well sampling, on-site soil sampling, groundwater elevation measurements.

- January 2013. *Perfluorochemical (PFC) Assessment Interim Report and Proposed Work Plan for Additional PFC Assessment Activities for the 3M Cordova, IL Facility.* Prepared by Weston Solutions, Inc. for the 3M Company. **Results presented**: on-site soil sampling (April/May 2012), off-site residential well sampling (August 2012), groundwater elevation measurements (August 2012). **Proposed additional work**: off-site residential well sampling, groundwater elevation measurements, on-site monitoring and production wells sampling, piezometers installation, on-site soil sampling, off-site surface water sampling.
- October 2013. *Perfluorochemicals (PFCs) Assessment Program Pore Water and Surface Water Sampling Work Plan.* Prepared by Weston Solutions, Inc. for the 3M Company. **Proposed additional work**: off-site surface water and pore water sampling.
- November 2013. *3M Cordova, IL Near-Field Dye Tracing Study.* Prepared by Weston Solutions, Inc. for the 3M Company. **Proposed additional work**: off-site wastewater discharge mixing study.
- February 2014. *2013 Assessment Activities Summary Report for the 3M Cordova, IL Facility.* Prepared by Weston Solutions, Inc. for the 3M Company. **Results presented**: off-site residential well sampling (February 2013), on-site soil sampling (April/May 2013), on-site monitoring and production well sampling (June, November and December 2013), groundwater elevation measurements (February, June and November 2013), off-site surface water sampling (August and November 2013), off-site pore water sampling (November 2013).

All of the reports listed above have been submitted to the IL EPA. For brevity, this document does not attempt to capture all of the detail reflected in the body of work represented. It should be noted that the February 2014 report was developed to not only document the 2013 work that was completed, but also to compile much of the data acquired over the 7+ year timeframe of this assessment. As such, it is intended to serve as a convenient reference to the extensive and detailed data that has been generated in the course of this study.

3. Remediation objectives

At the start of this assessment, no remediation objectives had been established within the State of Illinois for any of the PFCs being evaluated. At the request of the IL EPA Project Manager assigned to the Cordova environmental assessment, the IL EPA's Toxicity Assessment Unit derived site specific remediation objectives for PFOS, PFOA and PFBA. These were provided to 3M via a letter dated April 6, 2010 (Appendix C). The listed values were based on the best information available at the time and, in fact, it was noted that insufficient scientific data existed to attempt to establish guidance criteria for PFHS or PFBS.

There are two other locations within the United States where PFCs have been extensively studied and where cleanup criteria have been established – Minnesota and Alabama. For the sake of comparison, these values are listed along with those derived by the IL EPA and observations are offered concerning similarities and differences.

For water, the State of Minnesota has adopted Health Risk Limits (HRLs) for PFOS, PFOA, PFBA and PFBS. These are adopted by rule and intended to be protective of water supplies for a lifetime consumption exposure scenario. Based on a major environmental investigation being conducted in northern Alabama in 2007-2008, the U.S. EPA established Provisional Health

Advisories for PFOS and PFOA. A fact sheet summarizing the Alabama assessment is provided as Appendix D. The following table summarizes and compares the drinking water criteria developed by each regulatory agency:

	Drinking Water Criteria				
	PFOS	PFOA	PFBA	PFBS	PFHS
IL EPA (Class I)	0.2	0.4	20	None	None
MN Dept. of Health HRL's	0.3	0.3	7	7	None
U.S. EPA PHA's	0.2	0.4	None	None	None

All results are reported in ug/L (ppb). In general, the differences between the three areas are relatively minor. (Of note, U.S. EPA recently released Draft Health Effects Documents for PFOA and PFOS that could eventually bring about changes to the values listed above. The timing of this is uncertain, but no changes would be anticipated until 2015 at the earliest.)

In similar fashion, a comparison can be made between soil criteria that have been developed for each of the three areas. For PFOS, the following table summarizes and compares the soil criteria developed by each regulatory agency:

PFOS	Soil Ingestion				Groundwater Ingestion
	Residential	Industrial/Commercial	Construction Worker	Recreational	Soil Component of the Groundwater Route
IL EPA	2,000	53,000	16,000	None	4.1
MPCA	2,100	14,000	None	2,600	None
U.S. EPA	6,000	None	None	None	None

All results are in ng/g (ppb).

For PFOA, the following table summarizes and compares the soil criteria developed by each regulatory agency:

PFOA	Soil Ingestion				Groundwater Ingestion
	Residential	Industrial/Commercial	Construction Worker	Recreational	Soil Component of the Groundwater Route
IL EPA	4,900	129,000	39,000	None	1,900
MPCA	2,100	13,000	None	2,500	None
U.S. EPA	16,000	None	None	None	None

All results are in ng/g (ppb).

For PFBA, the following table summarizes and compares the soil criteria developed by each regulatory agency:

PFBA	Soil Ingestion				Groundwater Ingestion
	Residential	Industrial/Commercial	Construction Worker	Recreational	Soil Component of the Groundwater Route
IL EPA	230,000	5,900,000	590,000	None	160
MPCA	77,000	500,000	None	94,000	None
U.S. EPA	None	None	None	None	None

All results are in ng/g (ppb).

For soil ingestion, the values vary somewhat due to slightly different exposure scenario assumptions. In any event, all of the results for PFOS, PFOA and PFBA are in the parts per million range (1,000's of ppb). In contrast, for groundwater ingestion, it is notable that neither Minnesota nor the U.S. EPA has developed or utilized "soil component of the groundwater route" criteria for any PFC. Such values are of limited relevance and reliability (for this Site and PFCs generally) for several reasons:

- Such criteria are essentially redundant when water criteria are developed and monitoring of any given water supply can be performed. In other words, the ultimate objective of a "soil component of the groundwater route" criterion is to protect the groundwater at already established levels and this can be evaluated directly through straightforward groundwater monitoring approaches.
- The number of factors that impact such derivations are too numerous and complex, especially with PFCs, to reliably establish relevant objectives. In essence, the derivation of such values represents a modeling exercise that is fraught with uncertainty. Parameters contributing to this uncertainty include:
    - Type of soil
    - Types of PFCs present
    - Concentrations of PFCs
    - Specific soil chemistry
    - Specific pore water chemistry
    - Precipitation amounts and patterns
    - Depth to groundwater
    - Hydraulic gradients of the aquifer
    - Adsorption and desorption parameters for each PFC

For the Cordova site specifically, the utility of having "soil component of the groundwater route" criteria is also diminished by the likelihood that "steady state" or equilibrium conditions now exist. This is expected for a number of reasons, including: sludge was first land applied almost 40 years ago, the practice ceased 15 years ago, the soils are sandy, the aquifer is relatively shallow, there is ample precipitation, and PFCs are mobile in the environment. Accordingly, levels in both soil and groundwater can be expected to be relatively stable and slowly diminish over time. This means, for this site and these materials, readily available and actual groundwater concentrations provide the most direct and reliable measure of potential future impacts. Indirect

measures such as the "soil component of the groundwater route" are inherently less reliable. Continued routine monitoring (proposal described herein) will confirm Site conditions.

4. Summary of assessment results

This section contains a summary review of the results generated in the course of this Assessment. For more detail, reference is made to the aforementioned Work Plans and Reports, especially the February 2014 *2013 Assessment Activities Summary Report* that contains a compilation of much of the detailed data.

a. Groundwater elevation measurements

As previously discussed under "Hydrogeology", groundwater elevation measurements have been taken on numerous occasions across the Site. These results are summarized graphically within Appendix B. Since 2006, as part of the current Assessment, eight different evaluations spanning every season of the year have been conducted. For seven of the eight datasets, clear and complete capture of groundwater beneath the entire Site is demonstrated by the high capacity well field that provides water for manufacturing purposes to the 3M Cordova facility. On occasion (example, August 2008), a groundwater divide can be observed just to the east of the Site's manufacturing operations. To the east of this divide, the same pattern of complete capture by the production well field is observed. To the west of the divide, the natural east-to-west gradient of groundwater movement towards the river is observed. In all circumstances, and as supported by groundwater monitoring for PFC constituents (see below), there are no apparent off-site impacts due to groundwater migration away from the Site. With the recent addition of several new wells, and the ongoing replacement of aging wells that have diminished pumping capacity, the groundwater capture at the Site is believed to have been further enhanced.

b. Groundwater concentrations

i. Off-site – residential wells

With property owners' consent, up to three rounds of private well sampling were performed for nearby residents at the locations shown on Figure 5. Results are summarized as follows:

Well ID	Date Sampled	Average Sample Concentration (ng/mL, ppb)				
		PFBA	PFOA	PFBS	PFHS	PFOS
23321	July 2011	0.224	<0.0250	<0.0250	<0.0250	<0.0250
	August 2012	0.451	<0.0240	<0.0250	<0.0250	<0.0232
	February 2013	not sampled	not sampled	not sampled	not sampled	not sampled
22610	July 2011	0.182	<0.0250	<0.0250	<0.0250	<0.0250
	August 2012	0.105	<0.0240	<0.0250	<0.0250	<0.0232
	February 2013	0.157	<0.0240	<0.0250	<0.0250	<0.0232
22704	July 2011	0.452	<0.0250	<0.0250	<0.0250	0.0412
	August 2012	0.739	<0.0240	<0.0250	<0.0250	<0.0232
	February 2013	1.01	<0.0240	<0.0250	<0.0250	<0.0232
22703	July 2011	0.0783	<0.0250	<0.0250	<0.0250	<0.0250
	August 2012	not sampled	not sampled	not sampled	not sampled	not sampled
	February 2013	0.0702	<0.0240	<0.0250	<0.0250	<0.0232
22414	July 2011	0.0673	<0.0250	<0.0250	<0.0250	<0.0250
	August 2012	not sampled	not sampled	not sampled	not sampled	not sampled
	February 2013	0.630	<0.0240	<0.0250	<0.0250	<0.0232
22009	July 2011	3.41	<0.025	<0.025	<0.0250	<0.0250
	August 2012	not sampled	not sampled	not sampled	not sampled	not sampled
	February 2013	not sampled	not sampled	not sampled	not sampled	not sampled
21421	July 2011	1.73	<0.0250	0.0583	<0.0250	<0.0250
	August 2012	2.16	<0.0240	0.0294	<0.0250	<0.0232
	February 2013	2.27	<0.0240	0.0364	<0.0250	<0.0232

The site-specific remediation objectives for groundwater are 0.2 ng/mL (ppb) for PFOS, 0.4 ng/mL for PFOA and 20 ng/mL for PFBA. Results for all wells and all analytes are consistently and significantly below the groundwater objectives for drinking water. For four of the five constituents, results were dominated by outcomes less than the limits of quantitation.

ii. Off-site – commercial wells

With property owners' consent, non-potable wells at nearby commercial properties were sampled in December 2009. Well locations are provided in Figure 6. Results are summarized as follows:

Well ID	Date Sampled	Average Sample Concentration (ng/mL, ppb)				
		PFBA	PFOA	PFBS	PFHS	PFOS
Riverstone (C-1)	Dec 2009	0.788	<0.0303	<0.0255	<0.0250	<0.0253
Westway (C-2)	Dec 2009	4.51	<0.0303	0.145	<0.0250	<0.0253
CFI (C-3)	Dec 2009	0.0767	<0.0303	<0.0255	<0.0250	<0.0253
CFI (C-4)	Dec 2009	0.211	0.0937	<0.0255	<0.0250	0.0413
CFI (C-5)	Dec 2009	0.541	0.0357	0.0255	<0.0250	<0.0253

As was observed for the off-site residential wells, all results for all off-site commercial wells and all analytes are significantly below the groundwater objectives for drinking water.

iii. On-site – production wells

The locations of the on-site production wells are provided in Figure 3. Results are summarized as follows:

Well ID	Date Sampled	Average Sample Concentration (ng/mL, ppb)				
		PFBA	PFOA	PFBS	PFHS	PFOS
PW-11	Aug 2006	no analysis	0.216	no analysis	no analysis	0.424
	Mar 2008	2.22	0.0656	<0.0249	0.094	0.266
	Dec 2009	2.09	0.118	<0.0255	0.111	0.278
	Jun 2013	1.52	0.183	<0.0250	0.190	2.42
	Sep 2013	2.18	0.205	<0.0250	0.205	2.53
	Nov 2013	2.00	0.139	<0.0250	0.144	1.87
	Dec 2013	2.26	0.146	0.0293	0.159	1.66
PW-12	Aug 2006	no analysis	0.735	no analysis	no analysis	2.91
	Mar 2008	3.89	0.500	<0.0249	0.530	2.91
	Dec 2009	4.41	1.38	0.0387	1.23	11.3
PW-112	Sep 2013	6.20	1.11	0.0436	1.23	23.2
	Nov 2013	6.43	1.19	0.0509	1.33	25.8
	Dec 2013	6.51	1.21	0.0662	1.29	28.9
PW-13	Aug 2006	no analysis	4.64	no analysis	no analysis	11.8
	Mar 2008	60.9	4.16	1.82	4.84	11.4
	Dec 2009	57.4	7.93	1.63	6.46	14.8
	Sep 2013	49.4	5.01	1.94	5.99	38.8
	Jun 2013	39.7	5.58	1.80	6.61	44.6
	Nov 2013	64.7	8.36	3.71	10.4	42.9
	Dec 2013	61.8	7.29	3.06	8.73	45.1
PW-24	Aug 2006	no analysis	0.417	no analysis	no analysis	1.72
	Mar 2008	2.61	0.455	<0.0249	0.445	3.49
	Dec 2009	1.45	0.347	<0.0255	0.408	0.727
	Sep 2013	1.80	3.12	<0.0250	0.345	9.17
	Jun 2013	1.29	0.242	<0.0250	0.291	5.93
	Nov 2013	1.26	0.333	<0.0250	0.420	5.50
	Dec 2013	1.56	0.290	0.0298	0.386	3.45
PW-37	Aug 2006	no analysis	0.591	no analysis	no analysis	0.159
	Mar 2008	1.39	0.449	<0.0249	0.283	0.838
	Dec 2009	1.39	0.342	<0.0255	0.401	0.698
	Jun 2013	0.521	0.223	<0.0250	0.293	1.46
	Sep 2013	0.691	0.219	<0.0250	0.308	1.60
	Nov 2013	0.949	0.243	<0.0250	0.350	2.31
	Dec 2013	1.05	0.264	0.0307	0.361	2.42
PW-91	Jun 2013	1.73	<0.0240	<0.0250	<0.0250	<0.0232
	Sep 2013	1.80	<0.0958	<0.0250	<0.0250	<0.0232
	Nov 2013	2.07	<0.0240	<0.0250	<0.0500	<0.0464
	Dec 2013	2.26	<0.0240	<0.0250	<0.0500	<0.0464
PW-94	Dec 2009	5.11	<0.0303	0.0604	<0.0250	<0.0253
	Jun 2013	4.76	<0.0240	0.0687	<0.0250	<0.0232
	Sep 2013	5.56	<0.0958	0.0622	<0.0250	<0.0232
	Nov 2013	4.86	<0.0240	0.0569	<0.0500	<0.0464
	Dec 2013	5.39	<0.0240	0.0727	<0.0500	<0.0464

The on-site production wells fall into three basic groupings. First, wells PW-91 and PW-94 on the southern boundary of the property and well field have the lowest observed levels with many results less than limits of quantitation. All three groundwater objectives are consistently met for these two wells. In contrast, the two well locations in the center of the well field, PW-112 (replacing PW-12) and PW-13, have consistently demonstrated the highest observed concentrations for each constituent. The site-specific groundwater objectives for drinking water for PFOS and PFOA are not met for these wells with concentrations generally one to two orders of magnitude higher than the criteria. The objective for PFBA is met at the PW-112/PW-12 location but not at PW-13. Finally, the three remaining wells (PW-37 and PW-24 to the north and PW-11 to the east and down-gradient from the west-to-east induced flow created by PW-112 and PW-13) demonstrate intermediate levels of PFCs. The groundwater objectives for drinking water for PFOA and PFBA are generally met for these wells while concentrations observed for PFOS are higher than its criterion. As noted previously, the water from on-site production wells is not used as a drinking water source.

Due to changes in well field pumping (the recent addition of wells PW-91 and PW-94, the decommissioning of PW-12 in early 2013 and the addition of its replacement, PW-112, during late summer 2013) PFC groundwater concentration trends for individual wells cannot yet be determined. A program to monitor these wells on a quarterly basis is in place, and is proposed to continue, to evaluate trends in PFC concentrations.

iv. On-site – manufacturing area monitoring wells

The locations of the on-site monitoring wells installed in the manufacturing area of the Site are provided in Figure 4. Results are summarized as follows:

Well ID	Date Sampled	Average Sample Concentration (ng/mL, ppb)				
		PFBA	PFOA	PFBS	PFHS	PFOS
MW-1-88	Mar 2008	17.5	0.519	not reported	0.630	0.142
	Dec 2009	158	5.85	124	6.04	41.8
	Jun 2013	16.3	1.29	23.4	3.38	3.43
MW-1-90	Mar 2008	110	0.369	5.35	0.628	1.25
	Dec 2009	426	5.38	95.8	6.790	37.0
	Jun 2013	not sampled	not sampled	not sampled	not sampled	not sampled
MW-2-90	Mar 2008	53.1	2.36	0.937	2.29	4.46
	Dec 2009	56.9	4.50	7.54	6.50	5.91
	Jun 2013	3.79	0.077	0.0882	0.077	4.55
MW-9-90R	Mar 2008	103	1.70	2.87	2.47	27.2
	Dec 2009	372	6.09	76.1	4.82	107
	Jun 2013	99.8	1.86	1.84	2.43	40.2
MW-1-93	Mar 2008	22.0	0.709	0.470	3.78	4.52
	Dec 2009	10.7	0.497	0.217	1.60	5.75
	Jun 2013	8.05	0.269	0.117	0.420	3.03
MW-3-94	Mar 2008	734	7.61	120	11.4	51.8
	Dec 2009	290	6.66	238	8.97	76.2
	Jun 2013	217	3.19	17.4	3.21	52.7
MW-1-81	Jun 2013	1.44	0.108	0.0775	0.0706	0.247
MW-4-94	Jun 2013	88.3	2.29	14.0	5.06	17.7
MW-7-90	Jun 2013	13.7	0.946	0.738	2.85	65.6

In general, the highest PFC concentrations in on-site groundwater have been observed in the manufacturing area. With the exception of MW-1-81, located generally towards the north where the former Magnetic Media plant operated, the groundwater objectives for PFOS, PFOA and PFBA are not met in these series of wells. No obvious trends are evident in the data generated to-date. As previously noted, this area is typically under the pumping influence of the Site well field. At those times when groundwater in this area is not flowing into the well field, it would flow to the west into the river. The water is not used as a drinking water source.

v. On-site – sludge incorporation area (SIA) monitoring wells

The location of the on-site monitoring wells situated in the former sludge incorporation areas of the Site are provided in Figure 4. Results are summarized as follows:

Well ID	Date Sampled	Average Sample Concentration (ng/mL, ppb)				
		PFBA	PFOA	PFBS	PFHS	PFOS
MW-1-79	Mar 2008	135	6.60	2.50	9.72	22.2
	Dec 2009	240	21.0	2.57	14.3	24.4
	Jun 2013	152	14.0	2.89	17.1	29.6
MW-3-79	Mar 2008	32.0	2.17	0.756	3.95	3.22
	Dec 2009	81.1	4.10	19.8	7.55	16.9
	Jun 2013	54.4	2.87	12.9	5.93	13.9
MW-4-79	Mar 2008	1.22	0.0320	0.0250	0.0339	0.0786
	Dec 2009	8.35	0.123	0.0533	0.0460	0.174
	Jun 2013	3.16	0.154	0.0861	0.275	0.121
MW-3-81	Mar 2008	41.3	3.56	0.189	4.32	5.94
	Dec 2009	48.7	5.19	0.357	5.40	7.54
	Jun 2013	40.0	3.98	0.356	6.95	25.5
MW-7-94	Mar 2008	53.7	2.45	0.821	4.98	11.0
	Dec 2009	63.4	7.23	1.90	7.68	20.8
	Jun 2013	28.3	2.04	0.311	4.45	5.44
MW-8-94	Mar 2008	98.4	4.00	1.05	not reported	1.34
	Dec 2009	67.6	12.2	1.04	15.3	1.27
	Jun 2013	39.3	3.23	0.48	3.15	7.30
MW-9-94	Mar 2008	14.8	0.0986	0.199	0.763	0.0878
	Dec 2009	63.5	4.80	0.894	6.91	1.93
	Jun 2013	46.8	1.88	5.41	2.99	13.3

In general, the groundwater objectives for PFOS, PFOA and PFBA are not met for these wells. A fair amount of variability is observed for all the constituents and in multiple wells across the three sampling events. As previously noted, this area is typically under the pumping influence of the Site well field. At those times when groundwater in the westernmost portion of the SIA is not flowing into the well field, it would flow to the west toward the river. The water is not used as a drinking water source.

vi. On-site – reference wells (i.e., non-SIA and non-production area locations)

Four monitoring wells at the Site are located outside of areas where sludge was formerly land applied and away from production operations. The locations of these on-site monitoring wells are provided in Figure 4. Results are summarized as follows:

Well ID	Date Sampled	Average Sample Concentration (ng/mL, ppb)				
		PFBA	PFOA	PFBS	PFHS	PFOS
MW-5-79	Mar 2008	0.400	<0.0298	<0.0249	<0.0244	<0.0250
	Dec 2009	<2.50	0.0865	0.0267	<0.0250	0.0548
	Jun 2013	0.528	0.0259	<0.0250	<0.0250	0.0448
MW-2-81	Mar 2008	2.34	<0.0298	0.260	<0.0293	<0.0250
	Dec 2009	6.04	0.0344	0.870	<0.0250	0.0538
	Jun 2013	3.92	<0.0240	0.163	<0.0250	0.0609
MW-4-81	Mar 2008	145	12.1	0.829	11.6	13.7
	Dec 2009	155	6.26	7.73	6.99	21.5
	Jun 2013	140	5.80	5.88	7.49	22.5
MW-5-81	Mar 2008	0.135	<0.0298	<0.0249	<0.0244	<0.0250
	Dec 2009	0.0891	<0.0303	<0.0255	<0.0250	<0.0253
	Jun 2013	0.0744	<0.0240	<0.0250	<0.0250	<0.0232

Three of the four well locations were placed near the property boundaries outside of areas where sludge was applied:

- MW-5-79 is located in the northern portion of the Site within Zone 11 where no sludge was ever applied.
- MW-2-81 is on the southern boundary of the 3M property just south of Zone 3.
- MW-5-81 is located in the far northeast corner of the Site.

The low PFC groundwater concentrations in these wells, along with the site-wide groundwater table elevations, indicate that the production wells have resulted in broad hydraulic containment of PFCs within the Site.

MW-4-81 is located in the middle of the 3M Cordova property. While not within a former sludge incorporation area, it is surrounded by Zones 4, 5, 8 and 12. PFC concentrations measured at this location indicate that the pumping wells likely have moved impacted groundwater past this point.

c. Soil concentrations – on-site sludge incorporation area (SIA)

Soils from the SIA zones were collected from various depths at 54 locations. Approximately 280 samples were obtained over the course of three field campaigns – March 2011, April/May 2012 and April 2013. The sample locations are depicted in Figure 7.

The following is a summary of the results:

- Results for PFBA range from below the limit of quantitation (BLOQ) (nominally 0.75 ng/g) to 83.9 ng/g with a median of 3.72 ng/g.
- Results for PFOA range from BLOQ (nominally 0.2 ng/g) to 71.8 ng/g with a median of 1.41 ng/g.
- Results for PFBS range from BLOQ (nominally 0.2 ng/g) to 1.95 ng/g with a median of 0.2 ng/g.
- Results for PFHS range from BLOQ (nominally 0.2 ng/g) to 80.6 ng/g with a median of 2.04 ng/g.
- Results for PFOS range from BLOQ (nominally 0.2 ng/g) to 5,710 ng/g with a median of 124 ng/g.

Relative to the soil remediation objectives derived for PFOS, PFOA and PFBA, all of the criteria (ingestion, inhalation and soil-to-groundwater ingestion) were easily met for all exposure scenarios (residential, industrial/commercial and construction worker) with the exceptions of the residential ingestion value of 2,000 ng/g for PFOS and the soil-to-groundwater ingestion value of 4.1 ng/g for PFOS. Out of almost 280 results, only five were greater than the 2,000 ng/g residential ingestion threshold; all but ten were greater than the 4.1 ng/g soil-to-groundwater ingestion value.

The soil concentration data are detailed in reports previously submitted to IL EPA. In particular, the *2013 Assessment Activities Summary Report,* submitted in February 2014, provides a compilation and summary of all the results generated. A careful evaluation of PFOS concentrations in soil with respect to horizontal and vertical locations indicates that PFOS is heterogeneously distributed across the Site. For example, there are locations where levels reach parts per million concentrations at the surface (example, Zone 9) but where concentrations immediately below the surface and at depth are relatively low. Conversely, there are areas where this pattern is reversed (example, Zone 3). Other than the control zone and the acquired southern strip of agricultural land that have very low readings, there do not appear to be clear or consistent trends for high or low concentrations across the zones.

d. Surface water concentrations – Mississippi River

i. <u>August 2013</u>

In August 2013, 3M collected 83 surface water samples from four transects as illustrated in Figure 8. At each ten-station transect, one or two samples were collected for each station based on water depth. The four transects were established to be approximately equally spaced with transect T-1 being just upstream of the developed portion of the Site and transect T-4 just downstream. The Site's wastewater discharge occurs via a submerged diffuser that is located between transects T-2 and T-3.

For the upstream transect T-1, all results were below limits of quantitation (BLOQ) for PFOS, PFHS and PFBS. It should be noted that the detection limits for this work were very low – 2.50 ng/L (ppt) for PFHS, PFBS and PFBA, 2.40 ng/L (ppt) for PFOA and 4.64 ng/L (ppt) for PFOS. PFOA results were generally at or below the LOQ. The background concentration of PFBA was generally constant across the transect and averaged 18 ng/L (ppt).

The levels observed for the upstream background transect T-1 were consistently observed at all stations across the other three transects with the exception of the easternmost location (Station 10) for transects T-3 and T-4. At these locations, the following ranges of concentrations were observed:

- PFBA – 2290 to 5560 ng/L
- PFOA – 11.4 to 25.3 ng/L
- PFBS – 14.3 to 35.1 ng/L
- PFHS – 11.1 to 26.3 ng/L
- PFOS – 117 to 276 ng/L

For the sake of comparison, the site-specific groundwater objectives for PFBA, PFOA and PFOS are 20,000 ng/L, 400 ng/L and 200 ng/L, respectively.

ii. November 2013

To evaluate the repeatability of the results observed for August 2013 and to expand on this work, six surface water transects were sampled in November 2013 as indicated in Figure 9. In addition to the four transects evaluated in August, transect T-5 was added approximately one river mile downstream from transect T-4 and transect T-6 was added an additional four miles downriver.

Upstream (background) concentrations in November were 20, 5.1, 5.1, 2.6 and 2.7 ng/L (ppt) for PFBA, PFOA, PFBS, PFHS and PFOS, respectively, based on transect T-1 and T-2 results. As was observed in August, these levels were seen throughout the downstream transects T-3, T-4 and T-5 with the exception of the easternmost locations (Station 10 and also Station 9 for transact T-5). At these transects, the following ranges of concentrations were observed for the Station 10 locations:

- PFBA – 4200 to 11,000 ng/L
- PFOA – 8.14 to 14.0 ng/L
- PFBS – 189 to 505 ng/L
- PFHS – 7.38 to 14.1 ng/L
- PFOS – 50.3 to 120 ng/L

Again, for the sake of comparison, the site-specific groundwater objectives for drinking water for PFBA, PFOA and PFOS are 20,000 ng/L, 400 ng/L and 200 ng/L, respectively. At transact T-6, the concentrations of all constituents are fairly evenly distributed across all ten sampling stations with slightly lower concentrations in the center or main channel of the river.

Figures summarizing the analytical results for each constituent are presented in Appendix E.

iii. Dye tracer study – November 2013

As part of the surface water sampling program conducted in November 2013, a tracer study was executed by adding dye to the 3M Cordova wastewater discharge. The objective of this work was to document the immediate downstream mixing of the effluent beyond the diffuser.

The results from this study are depicted in Figure 10 and indicate that the plume from the wastewater treatment plant diffuser contacts the eastern shoreline approximately 1000 feet downstream of the multi-port diffuser. Further downstream, the data show that the wastewater discharge plume is essentially attached to the eastern bank. These study results are consistent with the PFC monitoring results and indicate that, while there is an immediate and effective dilution within 100's of feet of the diffuser, the complete dispersion is somewhat slow to occur due to the laminar flow conditions in this portion of the river.

e. Pore water concentrations – Mississippi River

As part of the November 2013 field work campaign, 3M collected twenty pore water samples from five pore water transects as shown on Figure 8. The purpose of this work was to evaluate the potential for near-shore groundwater discharge from the facility into the Mississippi River. Pore water samples representing the interstitial water within river sediments at a depth of 0.5 to 1 foot below the top of the sediment were collected and analyzed for PFCs. In addition, surface water samples were collected from the water column above each pore water sampling location.

Groundwater elevation data was collected across the Site at the same time the pore water samples were collected. Unfortunately, given the time required to "work up" this data and plot it as a groundwater contour map for the Site, it was not available in a useful format at the time of sample collection. Subsequent analysis indicates that this was another time period when groundwater was flowing *from* the river towards the productions wells to the east.

Analytical results for the pore water samples, including the co-located surface water samples, are provided in Appendix F. Concentrations are observed to vary considerably within and across the pore water transects and do not correlate with observed in-stream measurements thus indicating little groundwater contribution to surface water PFC concentrations. In summary, given that the production wells appear to capture groundwater beneath the Site and likely draw all this water eastward most of the time, the infrequent hydraulic reversals would limit the mass contribution of PFCs from groundwater to surface water. Therefore, the potential mass flux of PFCs from groundwater into the river appears to be insignificant.

Remedial Action Considerations

1. Completed and further proposed actions

Several actions pertaining to the management of PFCs at the 3M Cordova facility have already been taken. These include:

- 3M corporate commitment to phaseout the manufacturing and use of perfluorooctanyl chemistries on a global basis.
- Discontinuation of the sludge incorporation program at the Site.
- Discontinuation of drinking of production well water at the Site.
- Modification of Site NPDES wastewater permit to include routine monitoring for PFCs.
- Execution of a site-wide environmental assessment for PFCs.

To these elements, 3M proposes to add the following:

- Establishment of a Groundwater Management Zone (GMZ) in accordance with State of Illinois rules and regulations and with IL EPA input and approval.
- Establishment and execution of a routine groundwater monitoring program for the Site and adjoining areas.
- Routine reporting to IL EPA on monitoring and other site-related activities (groundwater elevation measurements, production well pumping volumes, status of production wells, etc).

a. Groundwater Management Zone

3M understands that defining and managing a three-dimensional GMZ for the Site may be an appropriate course of action. Given the well-documented groundwater capture situation for the property (i.e., all groundwater beneath the Site is captured by the facility well field with limited exceptions when the westernmost groundwater may flow to the Mississippi River) and the fact that monitoring results on the northern and southern boundaries reflect very low PFC levels, it would appear that the surface areal extent of the GMZ could essentially be defined as the total area of the 3M Cordova property. In terms of depth, production well logs generally indicate a depth to groundwater of 60-70 feet bgs and total well depths of approximately 170-180 feet bgs.

Given the demonstrated lack of off-site groundwater impacts and capture by existing production wells, it does not appear necessary to extend the GMZ beyond 3M's property. Even without significant pumping, the natural east-to-west flow of groundwater would be expected to minimize risk of off-site groundwater impacts.

Routine monitoring (see below) will be used to demonstrate the ongoing effectiveness of the GMZ and to track PFC concentration trends in groundwater at and near the Site.

b. Groundwater Monitoring Program

Monitoring of groundwater at and adjacent to the Site for PFCs has been conducted since the production wells were first sampled in August 2006. To continue and formalize the monitoring program into the future, the following schedule is proposed:

Area	Well ID	Frequency	Comments
Production Area	MW-7-90	Quarterly	Highest PFOS level in June 2013
	MW-9-90R	Quarterly	Monitored since March 2008; highest PFOS level
	MW-3-94	Quarterly	Monitored since March 2008
Former Sludge Incorporation Area	MW-1-79	Quarterly	Zone 6; monitored since March 2008; highest PFOS level
	MW-4-79	Quarterly	Zone 9; monitored since March 2008
	MW-5-79	Quarterly	Zone 11; monitored since March 2008; functionally a background well
	MW-3-81	Quarterly	Zone 2; monitored since March 2008
	MW-7-94	Quarterly	Zone 12; monitored since March 2008
Site Production Wells	PW-11	Quarterly	Monitored since August 2006
	PW-13	Quarterly	Well will be decommissioned in 2014; monitored since August 2006
	PW-24	Quarterly	Monitored since August 2006
	PW-37	Quarterly	Monitored since August 2006
	PW-91	Quarterly	Monitored since June 2013
	PW-94	Quarterly	Monitored since December 2009
	PW-112	Quarterly	Monitored since November 2013
	PW-113	Quarterly	New well to be constructed in 2014; replaces PW-13
Residential Wells	23321	Annually	Eastnortheast of Site; monitored since July 2011
	22610	Annually	East of Site; monitored since July 2011
	22704	Annually	East of Site; monitored since July 2011
	22703	Annually	East of Site; monitored since July 2011
	22414	Annually	East of Site; monitored since July 2011
	22009	Annually	Eastsoutheast of Site; monitored July 2011
	21421	Annually	South of Site; monitored since July 2011

Notes:
1. Analytes to include PFBA, PFOA, PFBS, PFHS and PFOS
2. Residential wells will be sampled only with the permission of property owners
3. PW-13 will be sampled according to this schedule up until it is shut down
4. PW-113 will be sampled once it comes on-line

It is envisioned that this schedule will be followed for two full years (i.e., data generated for eight quarters). At the end of this time, a review and update to the schedule is suggested based on the results obtained. Any modifications to the schedule would only occur with the input and approval of IL EPA.

In addition to monitoring for PFC concentrations in groundwater, it is proposed that groundwater elevation measurements be continued on a quarterly basis for two full years.

c. Routine Reporting

3M proposes to submit a report compiling and summarizing the results generated from the monitoring program outlined above on an annual basis. It is suggested that calendar year results, beginning with 2014, be submitted to IL EPA by March 31st of the following year. 3M would also welcome the opportunity to continue to meet regularly with IL EPA personnel to review and discuss results as they're generated on an as-needed or as-requested basis.

Relative to nearby residential well monitoring, 3M would continue the practice of sharing analytical results with individual property owners once results for their wells were finalized. As before, 3M would also provide copies of these results to IL EPA as they're communicated to the residents.

2. Evaluation of alternate remedial approaches

The choice of remedial response actions in any given situation is dependent on several factors including mass and/or concentrations of constituents present, risks to humans and/or the environment, effectiveness in isolating and curtailing a release, technical feasibility, economic viability, etc. For the present 3M Cordova situation, based on the extensive monitoring that has been conducted and comparisons of this data to the site-specific remediation objectives that have been developed, it is apparent that no adverse human health or environmental impacts are to be expected. As such, executing cleanup actions will not have tangible benefits. Nevertheless, 3M has considered two basic approaches that might be considered in such a setting and offers the following additional analyses.

a. On-site consolidation and capping of impacted soils

In situations where high levels of constituents are present in limited and well-defined areas within unsaturated soils, such areas can be isolated by constructing an impervious cap over the impacted soils. Such a technique "cuts off" the infiltration of precipitation down through the impacted soils and the resultant leaching of constituents into groundwater. A variation on this approach is to excavate certain high-level soils ("hot-spots") and place them in an area to be capped.

For the Cordova site, there are several reasons why a consolidation/capping approach is not necessary, feasible or appropriate:

- There are no well-defined and specific areas with high concentrations of PFCs that could reasonably be isolated. In general, levels in the soil are not significant in comparison to the soil ingestion remediation objectives. More specifically, with the exception of five out of almost 280 PFOS results (<2%), all of the soil ingestion criteria are met at the Site. The only objective not consistently met by all PFOS results is the residential ingestion pathway set at 2,000 ng/g (ppb), which is not applicable for the Site's current and anticipated use as a controlled-access industrial facility. The maximum observed PFOS concentration was 5,710 ng/g. In comparison, the industrial/commercial criterion derived for PFOS by the IL EPA is 53,000 ng/g.

Besides not being significant in general, even those areas with elevated concentrations are dispersed across the Site and at varying depths. For example, the ten highest PFOS results (<4% of the total) are observed in the following zones and depths:

- Zone 2 – SB04, 2-3 ft bgs, 1440 ng/g
- Zone 4 – SB02, 5-6 ft bgs, 1400 ng/g
- Zone 4 – SB02, 10-11 ft bgs, 1048 ng/g
- Zone 6 – SB05, 0-1 ft bgs, 1450 ng/g
- Zone 7 – SB02, 5-6 ft bgs, 1700 ng/g
- Zone 8 – SB02, 1-2 ft bgs, 2910 ng/g
- Zone 9 – SB03, 0-1 ft bgs, 5710 ng/g
- Zone 9 – SB04, 0-1 ft, bgs, 1160 ng/g
- Zone 10 – SB01, 0-0.25 ft bgs, 2110 ng/g
- Zone 11 – SB01, 0-0.25 ft bgs, 2580 ng/g

These ten results occur in eight different zones and five different study-defined depths. The lack of clear and isolated areas with higher concentrations renders isolation infeasible.

- To the extent a "steady state" fate and transport situation likely already exists at the Site, a consolidation/capping approach is not required to eliminate a "slug" of material from entering the system. In other words, given that historic sources were terminated years ago (i.e., releases from the production areas and incorporation of WWTP sludge), and given that the PFCs in question would be generally mobile, especially in the sandy soils at the Site, it is likely that the levels documented by this assessment will be relatively stable and decline, albeit slowly, over time. Again, capping is not likely to materially impact this situation. Monitoring will be conducted to verify this premise.

- Broad spatial implementation of capping at the Site could adversely impact groundwater recharge to the point where the Site well field might experience diminished capacity. In other words, by restricting precipitation infiltration too severely, individual well pumping rates might have to be curtailed.

- To the extent capping is conducted at the Site, those areas would be removed from consideration for future possible business expansion opportunities.

b. Water treatment using granular activated carbon (GAC)

Granular activated carbon (GAC) treatment has proven effective in certain situations in removing PFCs from water. This technology can be reasonably effective at removing "C-8" PFCs such as PFOS and PFOA. It has very little capability to remove shorter chain compounds such as PFBS and PFBA.

For the Cordova site, there are several reasons why a GAC treatment approach is not necessary, feasible or appropriate:

- Impacted groundwater from the Site is not being used as a source of drinking water; therefore the benefits of removal of certain constituents by GAC have limited tangible value. Water is used for productive purposes within 3M's Cordova operations and discharged under an NPDES permit that includes PFC monitoring requirements.
- While groundwater from the Site is ultimately discharged to the Mississippi River pursuant to an NPDES permit, and does contain measureable levels of certain PFCs, rapid dispersion results in measured levels that have been shown to be below the site-specific baseline groundwater remediation objectives for Class I water (i.e., drinking water criteria), as a point of reference.
- Given the volume of water being pumped to supply the 3M Cordova manufacturing operations (and coincidentally providing a very high degree of capture of groundwater PFCs at the Site), the scale of the treatment system for such an application would be very large.
- As noted, GAC treatment is not an effect technology for all of the PFCs present at the Site.
- Other constituents present in the source water can either compete for adsorption sites on the carbon and/or create operational issues by plugging up the beds. Such phenomena hinder the technical and economic feasibility of a system.
- When applied to situations where the mass of constituents being removed is low and/or "breakthrough" of the carbon occurs rapidly, the offsetting environmental costs to run such systems can become significant and arguably exceed the value of constituent removal. More specifically, there are environmental and energy costs associated with transportation of carbon to and from the Site and also with the regeneration process used by carbon vendors to restore carbon to useable service.

Other remediation approaches such as on-site landfilling, off-site landfilling, off-site incineration, etc., could also be considered but are viewed as being far more impractical than the two discussed above.

3. Current extent and modeled migration of contamination

3M believes the extent of contamination has been established by the Assessment conducted to-date. This document has provided a high-level summary of these results. Additional details are available in reports previously submitted to the IL EPA. In summary, there is strong evidence to indicate that constituents of interest in this study are not migrating off-site. It is recognized that groundwater pumped and used in manufacturing operations is ultimately discharged to the Mississippi River. These low ppb levels are dramatically reduced by introduction to a major river system via a submerged discharge diffuser. Furthermore, the Site NPDES permit has recently been modified to include PFC monitoring conditions.

Modeling the fate and transport of PFCs is a challenging task. Fortunately, because of previous environmental investigations conducted at the Site, numerous existing monitoring wells were utilized to generate extensive "real world" data in lieu of modeling. The specific groundwater flow characteristics at the Site also obviated the need to pursue modeling predictions.

4. Potential impact to groundwater

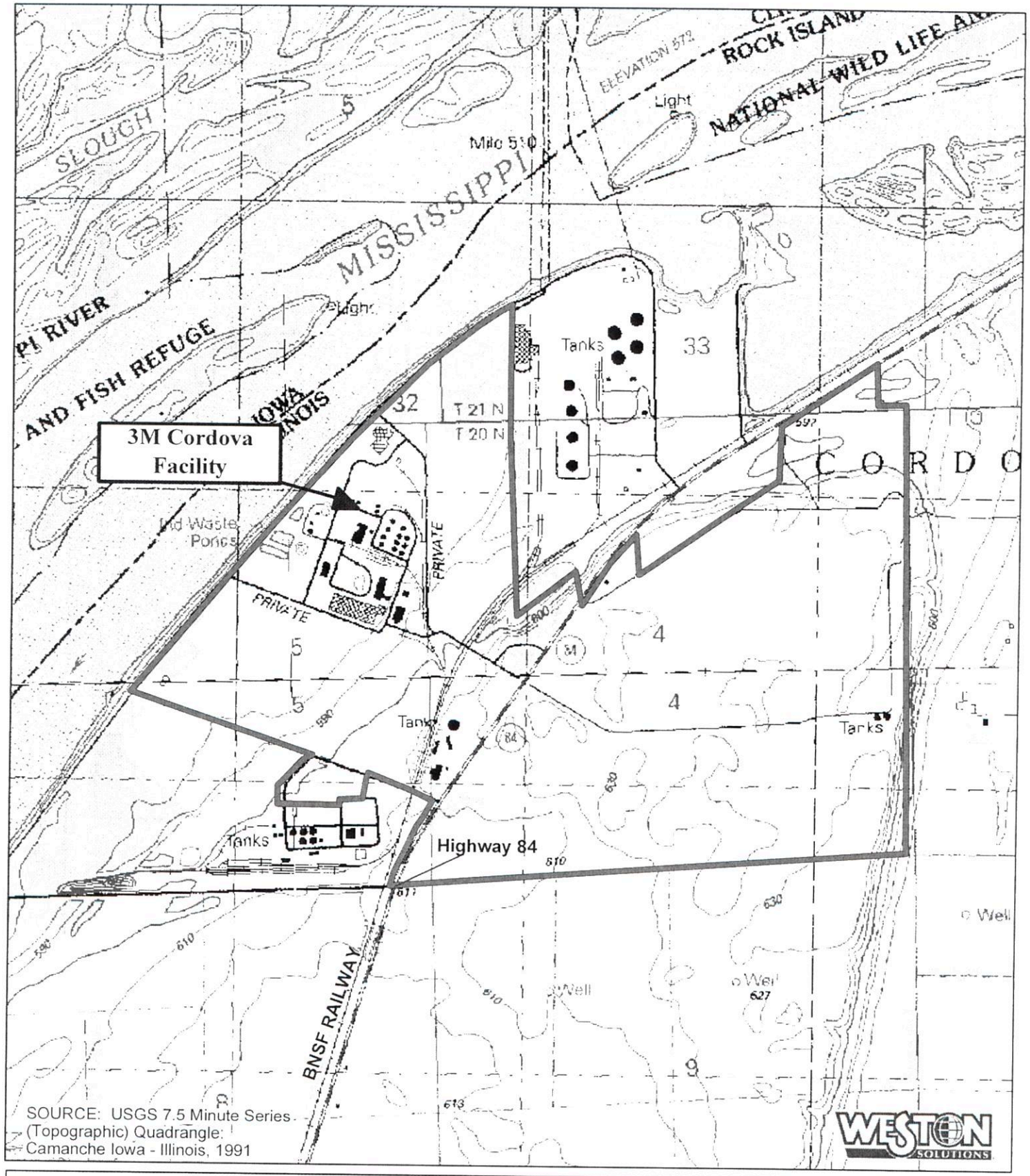
As described herein, data from the Assessment supports a conclusion that off-site groundwater has not been adversely impacted by releases from the Cordova site. In part, this is due to the

extensive well field and pumping of water required for operations at the Site. A monitoring program has been proposed to verify this conclusion into the future.

5. Present and post-remediation uses of the area of contamination, including human receptors at risk

   At present, the 3M Cordova facility is used exclusively by the company for its own manufacturing operations. This status is envisioned for the near and distant future, including post-remediation. The practice of renting portions of the property for agricultural purposes ended many years ago and will not be resumed. Based on data that has been generated and available criteria to interpret same, there is no apparent risk to human health or the environment.

Figures



Legend

Site Boundary

N
W E
S

0 1,500

Feet

Figure 1

Site Location Map
3M Cordova Facility
Cordova, Illinois

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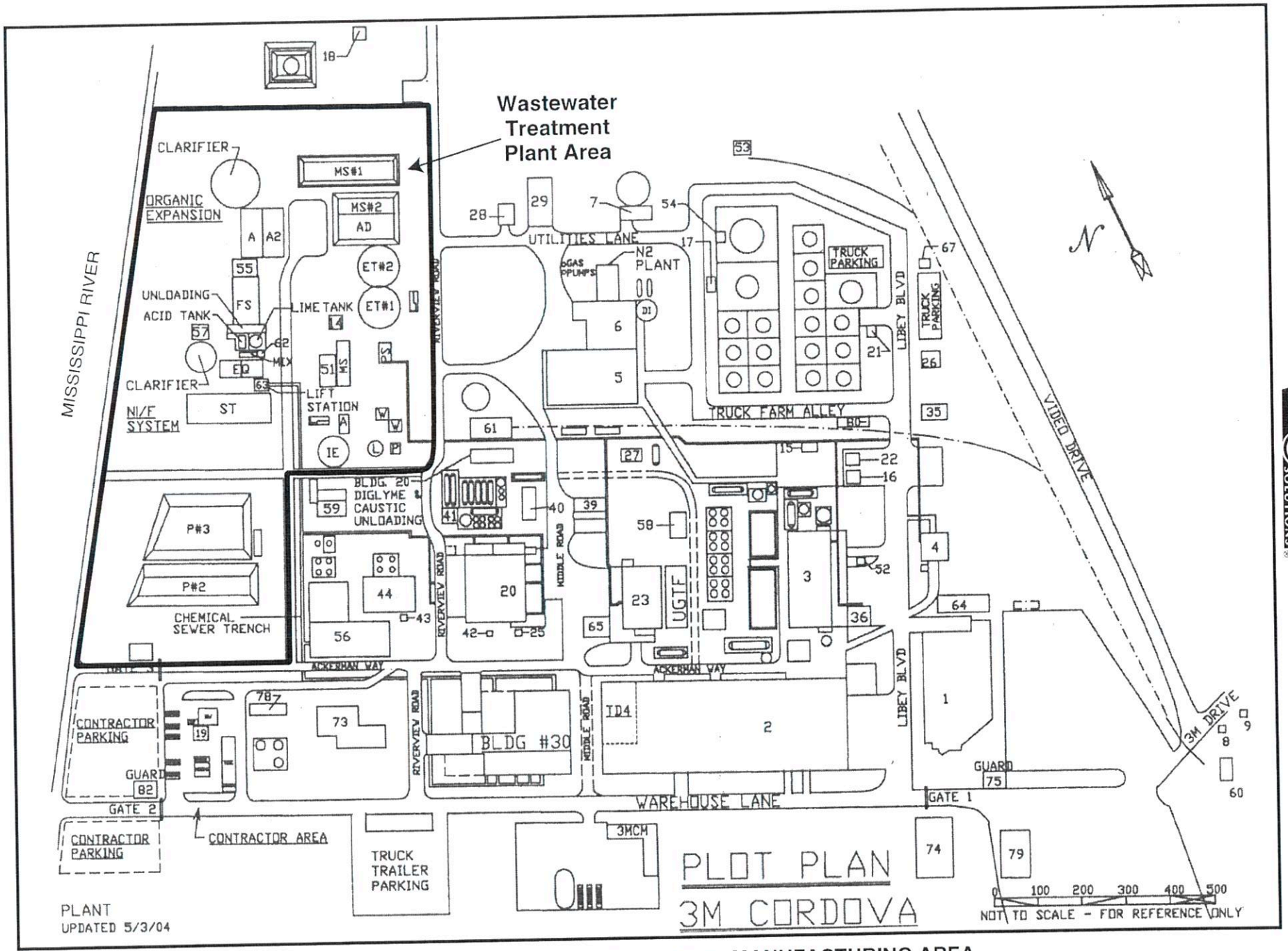
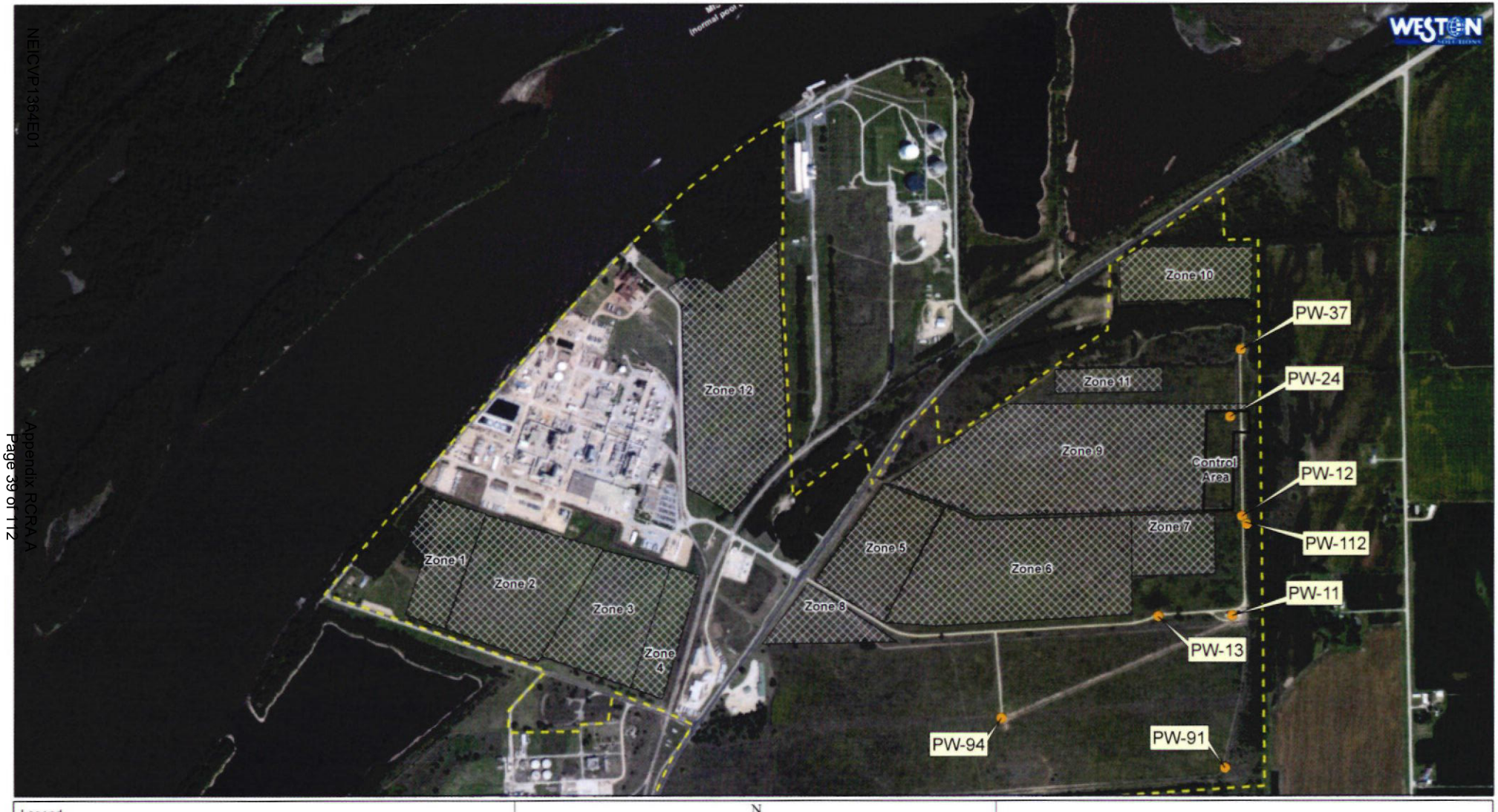


06P-1374-1b

Figure 2 **SITE LAYOUT, MANUFACTURING AREA**
3M CORDOVA, ILLINOIS



Legend

- survey_locations
- Production Well Location
- Fomer Sludge Incorporation Area Zones
- Site Boundary

N
W E
S

0 850 1,700
Feet

Imagery Source: ESRI, DigitalGlobe, GeoEye Mapping Service.

File: Y:\Cordova\MXD\Zones_PW_Locs.mxd, 2/28/2014 4:08:14 PM, johna

Figure 3
Former Sludge Incorporation Zones
and Production Well Locations
3M Cordova Facility
Cordova, IL

Figure 4
Groundwater Monitoring Locations
New Piezometer Locations
3M Cordova Facility
Cordova, IL

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Legend

Site Boundary

Residential Wells

N
W E
S

0 1,400
Feet

Imagery Source: ESRI, DigitalGlobe, GeoEye Mapping Service.

Figure 5
Residential Well Sampling Locations
3M Cordova Facility
Cordova, IL

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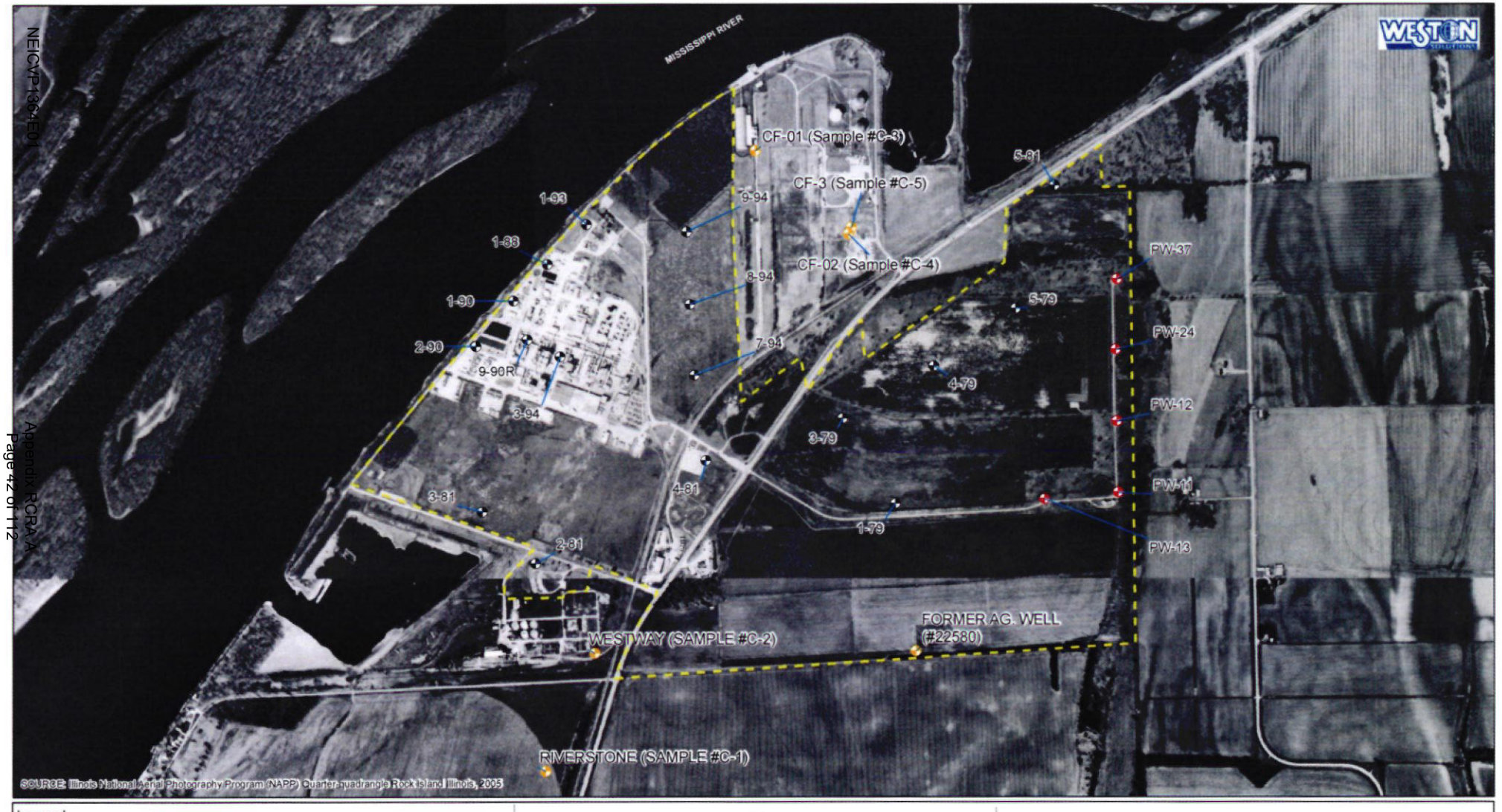


Legend

- Sampled Wells
- Production Wells
- Off-Site Wells
- Site Boundary

Note: Average sample concentrations are in ng/mL, ppb

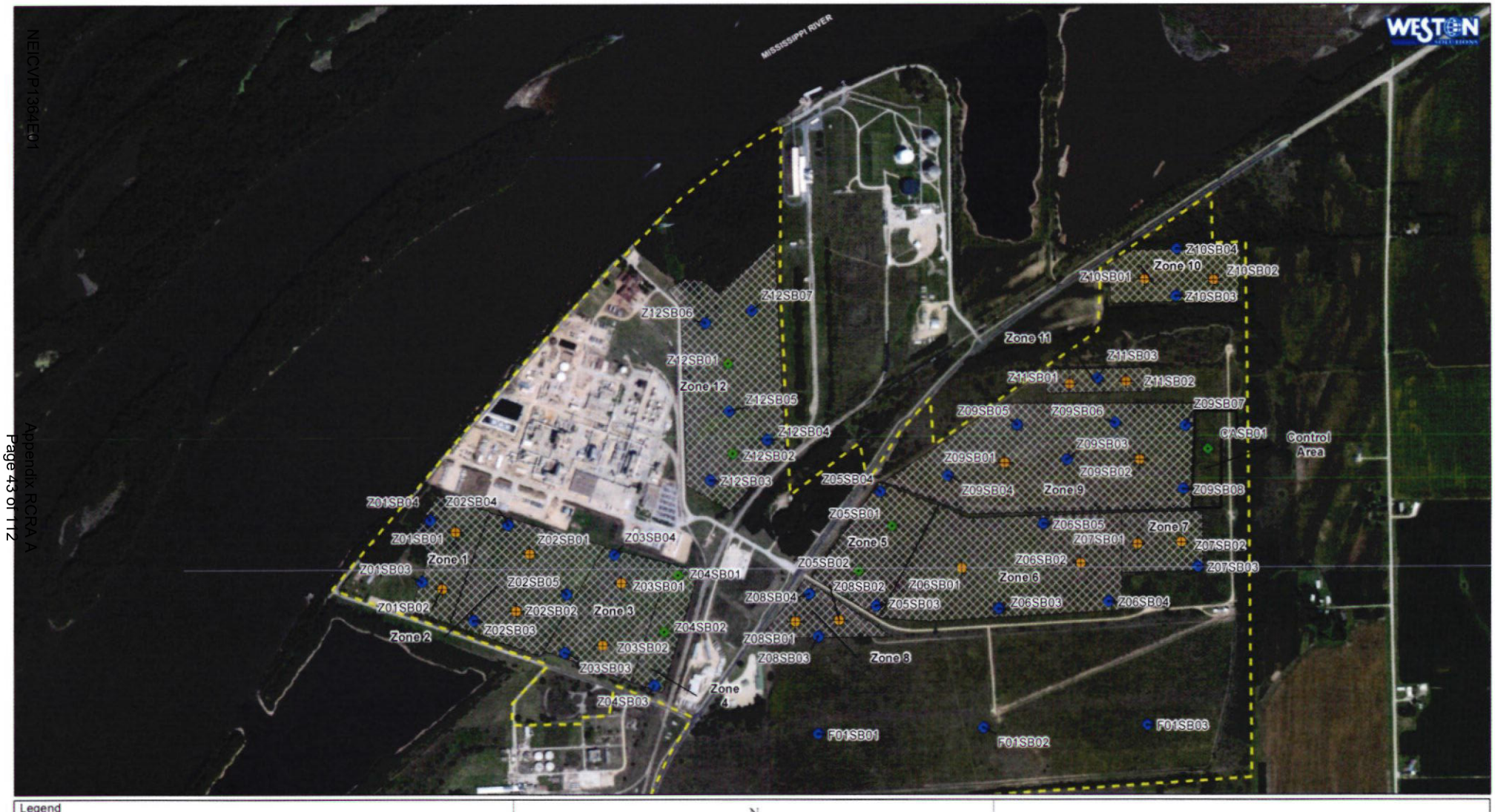
N W E S

0 1,000 2,000

Feet

Figure 6
Groundwater Sampling Locations
3M Cordova Facility
Cordova, IL

File: \\fsfed01.bgi\Cordova\MXD\gw_samp_locs.mxd, 18-Feb-10 11:28, rocksc



Legend

- March 2011 Soil Boring Location
- April/May 2012 Soil Boring Location
- April 2013 Soil Boring Location
- Former Sludge Incorporation Area Zones
- Site Boundary

N
W E
S

0 850 1,700
Feet

Imagery Source: ESRI, DigitalGlobe, GeoEye Mapping Service

Figure 7
Soil Boring Locations
March 2011, April/May 2012 and April 2013
3M Cordova Facility
Cordova, IL

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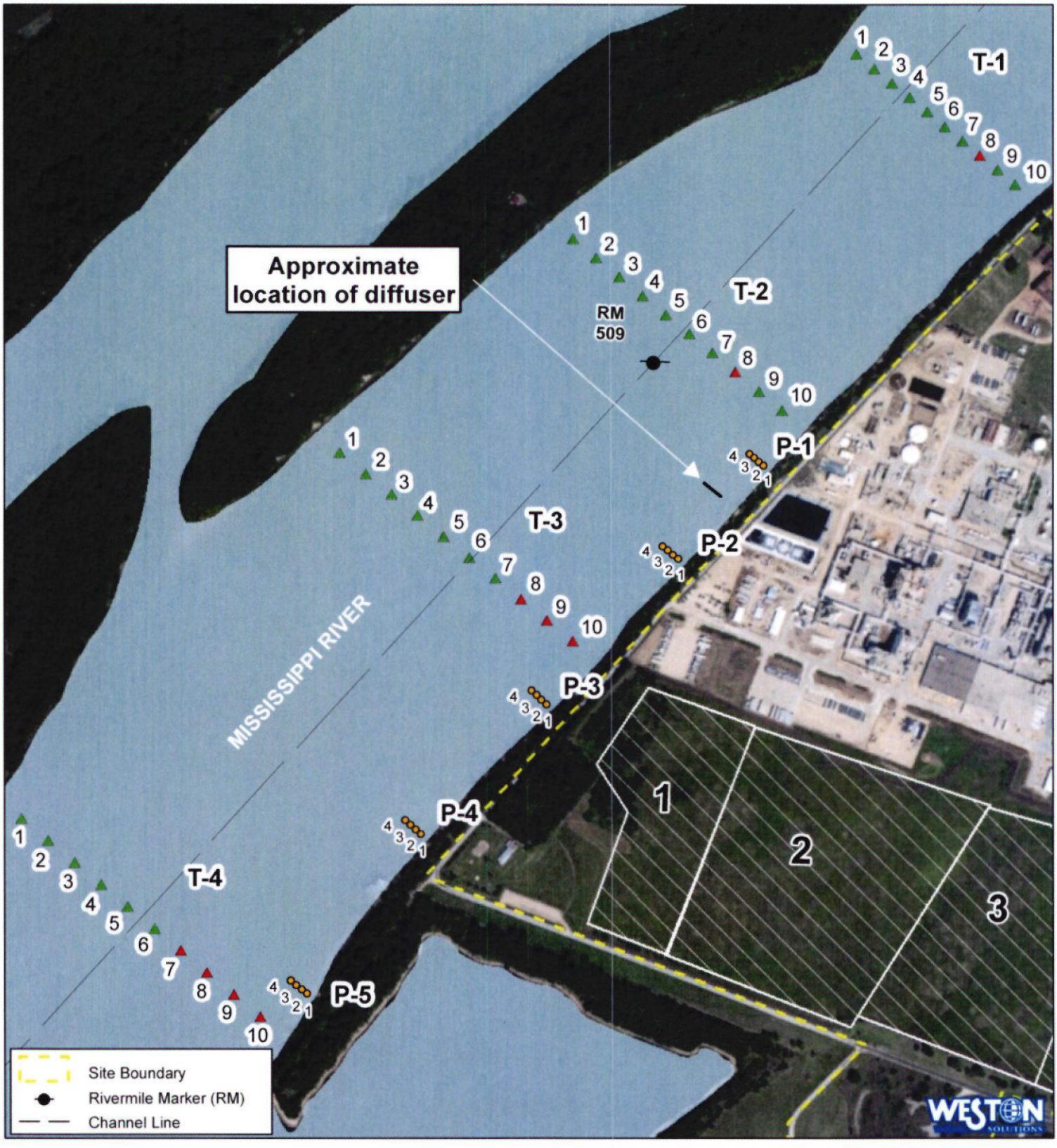


Legend

- Surface Water Sampling Transect Locations (August 2013)
- Additional Surface Water Sampling Locations (Resampled November 2013)
- Co-Located Surface Water/Pore Water Sampling Locations (November 2013)
- Former Sludge Incorporation Area Zones

N W E S

0 600 1,200

Feet

Imagery Source: ESRI, DigitalGlobe, GeoEye Mapping Service.

File: Y:\Cordova\MXD\Surface_PoreWater_Locations.mxd, 2/27/2014 2:18:39 PM, nicksc

Figure 8
Surface Water/Pore Water Sample Locations
3M Cordova Facility
Cordova, IL

Legend

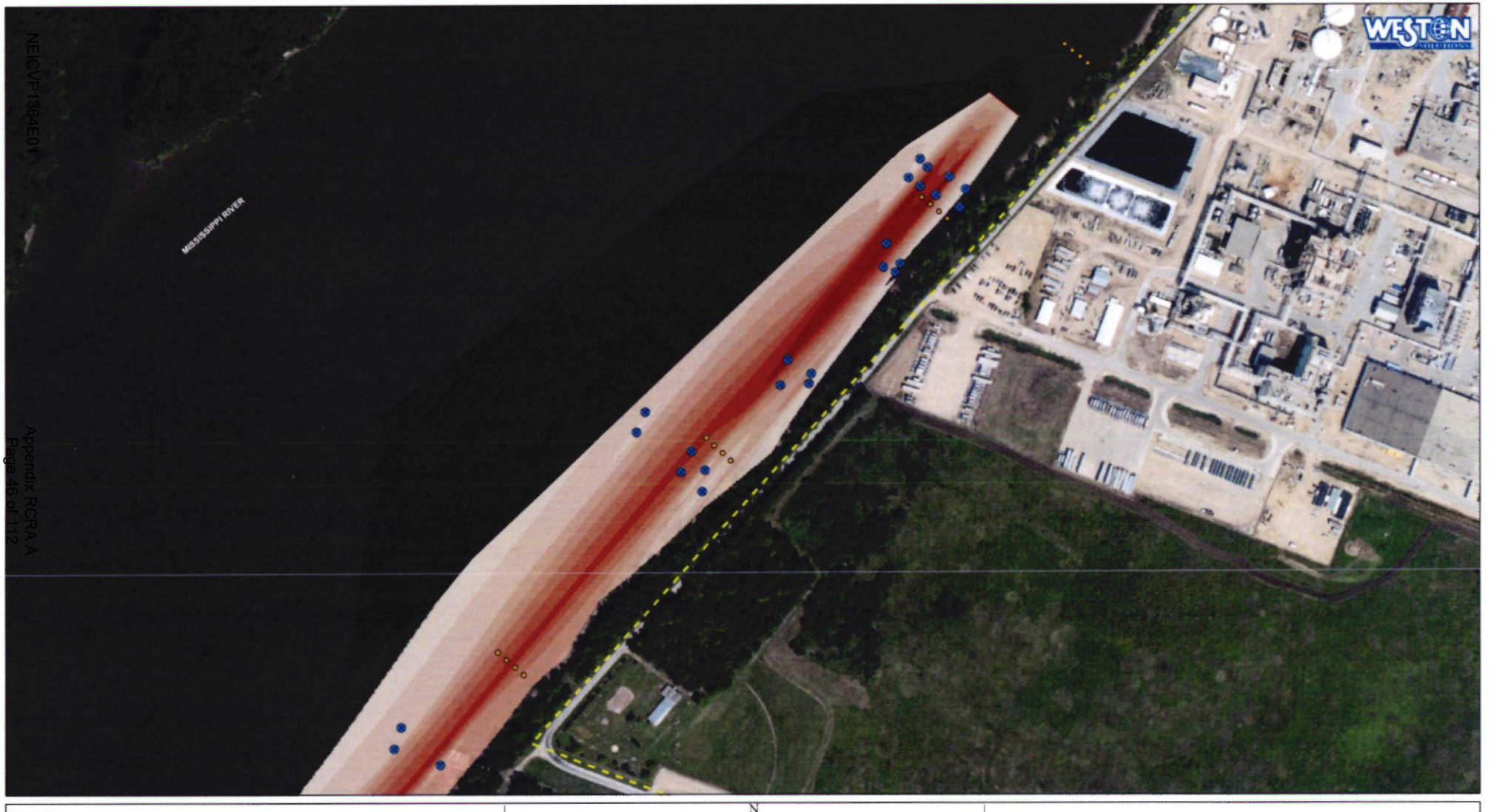
T1 Surface Water Transects (August 2013)

T3 Downstream SurfaceWater Transects (November 2013)

0 2,500 5,000 7,500

Feet

Figure 9
Downstream Surface Water Transects
November 2013
3M Cordova Facility
Cordova, IL



Legend

- Co-Located Surface Water/Pore Water Sampling Locations (November 2013)
- Channel Line
- Surface Water Locations
- Diffuser
- Site Boundary

Plume Concentration (Adjusted) in ppb

0.01 - 0.2	0.61 - 0.8	1.21 - 1.4
0.21 - 0.4	0.81 - 1	1.41 - 1.6
0.41 - 0.6	1.01 - 1.2	1.61 - 1.8

Notes:
-Adjusted Rhodamine WT dye concentration (ppb)
= Total fluorescence Background fluorescence.
-Background fluorescence of 7.13 ppb (as Rhodamine WT).

N W E S

0 250 500
Feet

Imagery Source: ESRI, DigitalGlobe, GeoEye Mapping Service.

3M Cordova
Cordova, Illinois

File: Y:\Cordova\MXD\SW_Fluorometry.mxd, 2/28/2014 11:28:55 AM, johnia

Figure 10
Surface Water Fluorometry
Plume Modeling
3M Cordova Facility
Cordova, IL

Appendix A

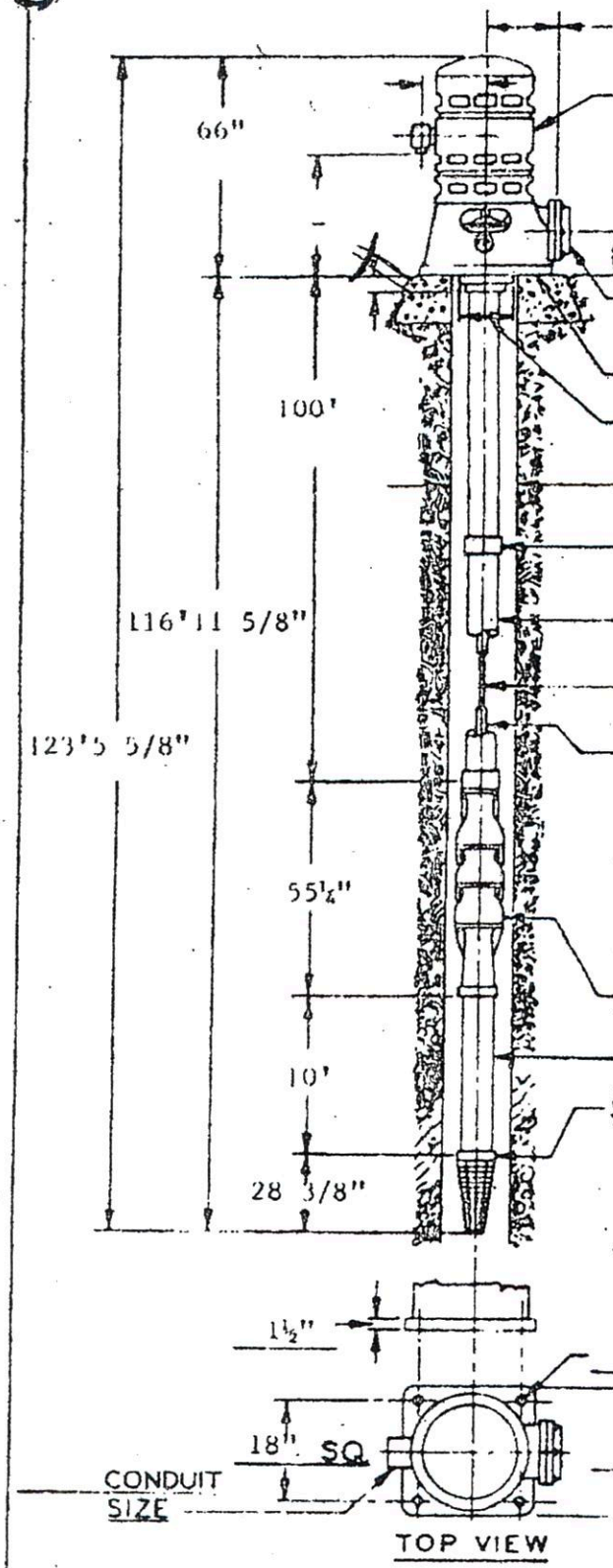
3M Cordova, IL
Site Production Well Information

FORM NO. 2020002 WELL [redacted]

WELL # 11
April 1969

PEERLESS PUMP

SURFACE DISCHARGE



10¼" ℄ TO FACE OF FLANGE

MOTOR U.S. MFR VHS TYPE

125 H.P. 60 CY 220/440 VOLTS

1760 R.P.M. 3 PH 444UP FRAME

9" BASE TO ℄ OF DISCHARGE

DISCHARGE COMPANION FLANGE FOR:

10x10x20 DISCHARGE HEAD

15" O.D. TOP COL. FLANGE

19¼" I.D. OF WELL

O.D. OF 11 3/4" COUPLING

10" COLUMN

1 11/16" SHAFT

None TUBE

BOWL UNIT:

14 MC ASSEMBLY

3 STAGE

13 3/8" O.D. OF BOWLS

10" SUCTION PIPE

STRAINER:

10" SIZE / 10 3/4" OD

Cal. Cone TYPE

1" DIA 4 HOLES

TOP VIEW

PUMP RATING

GPM 1750

FT FIELD HD 175'

Suction Screen is Stainless Steel

S.O. NO.

SOLD TO 3M

Project #67-6770

ORDER NO. AFE #6110

USER 3M

ITEM NO.

PUMP IDENTIFICATION

13P-01

THIS CERTIFIED PRINT

☐ FOR APPROVAL

BY _____ DATE _____

☐ FOR CONSTRUCTION

BY _____ DATE _____

HYDRODYNAMICS DIVISION
PEERLESS PUMP
Los Angeles 31, Calif - Indianapolis 8 Ind

DRN. BY CHK'D. BY DATE

Brotcke Well & Pump

CLOSED CIRCUIT TV DATA SHEET

Project 3M Company – Peerless Service **Job No.** 03082 **Date** 1/11/03

Location Cordova, Illinois **Diameter of Well** 20" **Depth of Hole** 179 ft

Well No. 11 **S.W.L.** 67 ft TOC* **Screen Type** Johnson Wire Wrap

Depth of Survey 179 ft **Counter; Electrical** X **Mechanical** ___

Depth To Top Of Screen 150 feet

DEPTH	DESCRIPTION AND REMARKS
0	Top of casing Side view of camera zeroed to top of casing
18	Weld Joint
38	Weld Joint
58	Weld Joint
67	Standing Water Level
150	Top of Screen
165	Screen Weld Joint
175	Screen slots appear to be blocked with iron (approximately 3" thick)
179	Bottom of Well

COMMENTS: Screen openings appeared to be unplugged.
Double Sonic-Blast was conducted.

*TOC: Measured from Top Of Casing

PW-11

THORPE WELL COMPANY

2340 SIXTH AVENUE
DES MOINES, IOWA

R-1-B

Drilled for 3-M Company at Cordova, Illinois

Well is located 200' miles ~~N-E-S-W~~ and miles N-E-S-W from of #4 PZ Hole

in the ¼ ¼ Section Township Range

Drilling started March 25 19 69 Completed April 1 19 69

BLDG 4 IN
Well No. Kind of Well Gravel Pack Depth Size hole started 42 in

Finish 30" G. P. M. 1500 Static Head 53' Pumping level from surface 69'

Water was first encountered at in Approx. Amt. Temp.

Remarks

(GIVE DETAILS OF PERFORATED PIPE AND SEALS)

RECORD OF PERMANENT PIPE					TEMPORARY PIPE	
SIZE PIPE	AMOUNT OF PIPE	DEPTH TO BOTTOM OF PIPE	DEPTH TO TOP OF PIPE	MAKE OF PIPE	SIZE PIPE	AMOUNT
36"	53"	51'	2' above gr.	Steel Casing		
20"	130'	128'	2' above gr.	Steel Casing		
20"	30'	158'	128'	.055 slot Johnson Screen #2 Gravel		

Driller Guy Lemar From Surface to feet

Driller Darwin Evans From feet to feet

Driller From feet to feet

AMOUNT IN FEET	KIND OF SOIL OR FORMATION (BE SPECIFIC)	TOTAL DEPTH FEET
1	Top soil	1
15	Coarse sand and gravel	16
45	Fine to medium sand and gravel	51
7	Fine to medium sand	58
27	Medium to coarse sand and gravel and boulders	85
68	Fine to medium sand	153
5	Fine sand	158

PW-12

WELL SURVEYS COMPANY

Box 81
Holcomb, Kansas 67851

CLOSED CIRCUIT TV DATA SHEET

Customer PEERLESS SERVICE CO. - 3M CORP.

Area Cordova Plant Date November 24, 1994

Well No. 12 S.W.L. 66' Depth of Hole

Depth of Survey 168'

Depth & Kind of Perforations: 20" stainless steel rod-base wire-wrapped screen 139'-T

Remarks: 20" steel casing. 20" stainless steel screen. All welded joints seemed good and secure.

DESCRIPTION & REMARKS	DEPTH OF COUNTER ELECTRONIC	MECHANICAL
Top of concrete pump base	0'	
Welds	9',29',52'	
Static water level	66'	
Welds	73',94',115'	
Rub marks from bowl assembly	121',122'	
Weld - top of wire-wrapped screen	139'	
Weld in screen	154'	
TD of well when surveyed	168'	

The screen was very clean, except for some build-up on the bottom 2'. It is probable that encrustation reducing production is occurring in the gravel pack area. The well was sonic cleaned. We used no sample basket, so we were able to extend the cleaning process as close as possible to the bottom of the scree No water was available for clarification, so no follow-up video inspection was performed.

PW-12

THORPE WELL COMPANY

2340 SIXTH AVENUE
DES MOINES, IOWA

Drilled for 3-M at Cordova, Ill.

Well is located 800'N. of #3 Well miles N-E-S-W and ____ miles N-E-S-W from ____

in the ____ ¼ ____ ¼ Section ____ Township ____ Range ____

Drilling started 3-4 19 69 Completed ____ 19 ____

Well No. 1 2 Kind of Well Gravel Pack Depth 168 Size hole started 42" in

Finish 30" G. P. M. 1800 Static Head 52' Pumping level from surface 73'

Water was first encountered at ____ in ____ Approx. Amt. ____ Temp. ____

Remarks ____

(GIVE DETAILS OF PERFORATED PIPE AND SEALS)

RECORD OF PERMANENT PIPE					TEMPORARY PIPE	
SIZE PIPE	AMOUNT OF PIPE	DEPTH TO BOTTOM OF PIPE	DEPTH TO TOP OF PIPE	MAKE OF PIPE	SIZE PIPE	AMOUNT
36"	53'	51'	2' above gr.	Steel Casing		
20"	140'	138'	2' above gr.	Steel Casing		
20"	30'	168'	138'	Johnson screen ,055	#2 Gravel	

Driller Guy Lemar From Surface to ____ feet

Driller Dawin Evans From ____ feet to ____ feet

Driller ____ From ____ feet to ____ feet

AMOUNT IN FEET	KIND OF SOIL OR FORMATION (BE SPECIFIC)	TOTAL DEPTH FEET
1	top soil	1
22	Med. fine to coarse sand and gravel	23
4	Fine to med. sand	27
24	Med. fine to coarse sand and gravel	51
31	Med. sand and gravel	81
4	Very fine sand	85
6	Med. fine to coarse sand	

PW-13

WELL SURVEYS COMPANY

Box 81
Holcomb, Kansas 67851

CLOSED CIRCUIT TV DATA SHEET

Customer 3M CORDOVA PLANT

Area North of Cordova, Illinois Date March 31, 1993

Well No. 13 S.W.L. 64' Depth of Hole

Depth of Survey 159'

Depth & Kind of Perforations: Stainless steel wire-wrapped screen 130'-TD.

Remarks: 20" steel casing with welded joints.

DESCRIPTION & REMARKS	DEPTH OF COUNTER ELECTRONIC	MECHANICAL
Top of concrete pump base	0'	
Weld	3'	
Weld	26'	
Weld	47'	
Static water level	64'	
Weld	69'	
Weld	88'	
More light-colored scale	105'	
Weld	107'	
Rub mark at 4:00 position	121'	
Weld - not even one side	130'	
Top of wire-wrapped screen	130'	
Weld - 5 scaly spots above weld	145'	
Slightly wider gap between wraps	148'	
Part of suction screen on bottom	159'	
TD of well when surveyed	159'	

PW-13

THORPE WELL COMPANY

2340 SIXTH AVENUE
DES MOINES, IOWA

Permit No. II

Drilled for 3-M Company at Cordova, Illinois

Well is located ____ miles N-E-S-W and ____ miles N-E-S-W from ____

in the ____ ¼ ____ ¼ Section ____ Township ____ Range ____

Drilling started February 7 19 69 Completed February 16 19 69

Well No. 13 Kind of Well Gravel Pack Depth ~~177~~ 160' Size hole started 42" in

Finish 30" G. P. M. 1500 Static Head 54' Pumping level from surface 72'

Water was first encountered at ____ in ____ Approx. Amt. ____ Temp. ____

Remarks ____

(GIVE DETAILS OF PERFORATED PIPE AND SEALS)

RECORD OF PERMANENT PIPE					TEMPORARY PIPE	
SIZE PIPE	AMOUNT OF PIPE	DEPTH TO BOTTOM OF PIPE	DEPTH TO TOP OF PIPE	MAKE OF PIPE	SIZE PIPE	AMOUNT
36"	52'	50'	2'	Steel Casing		
20"	149'	147'	2'	Steel Casing		
20"	30'	177'	147'	.055 Johnson S.S.Screen	#2 gravel	

Driller Guy Lemar From Surf feet

Driller Darwin Evans From feet

Driller ____ From feet

13

AMOUNT IN FEET	KIND OF SOIL OR FORMATION (BE SPECIFIC)	FEET
1	Top Soil	1
56	Medium fine to coarse sand and gravel Boulders	57
31	Fine to Medium Sand	88
23	Fine Sand	111
65	Fine to medium coarse sand and boulders	176

PW-24

WELL SURVEYS COMPANY

Box 81
Holcomb, Kansas 67851

CLOSED CIRCUIT TV DATA SHEET

Customer PEERLESS SERVICE CO. - 3M CORP.

Area Cordova Plant Date November 24, 1994

Well No. 24 S.W.L. 63' Depth of Hole

Depth of Survey 167'

Depth & Kind of Perforations: 20" stainless steel rod-base wire-wrapped screen 136'-

Remarks: 20" steel casing. 20" stainless steel screen. All welded joints seeme good and secure.

DESCRIPTION & REMARKS	DEPTH OF COUNTER ELECTRONIC	MECHANICAL
Top of concrete pump base	0'	
Welds	7',28',49'	
Static water level	63'	
Welds	70',91',112'	
Weld - top of wire-wrapped screen	136'	
Weld in screen	152'	
TD of well when surveyed	167'	

The screen was encrusted somewhat, with the build-up becoming more severe as we went deeper. Below 155' the wire wraps were mostly covered. The screen was so cleaned, with samples of rust, small gravel, and iron bacteria slime being recovered. Following the cleaning, water was added to clarify the water. We wer able to inspect all but the last few feet following this clarification. The screen was clean and shiny, with the outer wire wraps clearly visible. Some ty of chemical treatment should follow to remove the iron bacteria slime.

PW-24

THORPE WELL COMPANY 24

2340 SIXTH AVENUE
DES MOINES, IOWA

Drilled for 3 - M Company at Cordova, Illinois

Well is located 3 miles N-E-~~X~~ and ____ miles N-E-S-W from Cordova, Illinois

in the ____ ¼ ____ ¼ Section ____ Township ____ Range ____

Drilling started ~~XXXX~~ November 28, 19 73 Completed January 8, 19 74

Well No. 5 24 Kind of Well Gravel Pack Depth 170 Size hole started 42 in.

Finish 35 G. P. M. 1575 Static Head 54' 6" Pumping level from surface 73' 4"

Water was first encountered at ____ in ____ Approx. Amt ____ Temp. 56°

Remarks 36" pipe cemented from 50' to ground level. No. 2 Northern Gravel used for pack.

(GIVE DETAILS OF PERFORATED PIPE AND SEALS)

RECORD OF PERMANENT PIPE					TEMPORARY PIPE	
SIZE PIPE	AMOUNT OF PIPE	DEPTH TO BOTTOM OF PIPE	DEPTH TO TOP OF PIPE	MAKE OF PIPE	SIZE PIPE	AMOUNT
36"	52'	50'	+ 2'	Welded		
20"	142'	140'	+ 2'	Welded		
20"	30'	170'	140'	Stainless steel screen ~~Johnson .055 slot~~		

Driller Don Wram From Surface to ____ feet

Driller Guy Lemar From ____ feet to ____ feet

Driller ____ From ____ feet to ____ feet

AMOUNT IN FEET	KIND OF SOIL OR FORMATION (BE SPECIFIC)	TOTAL DEPTH FEET
2	Sandy top soil	2
17	Fine to course sand	19
15	Fine sand	34
16	Med to course gravel	50
30	Fine sand	80
25	Course sand & gravel	105
11	Very fine sand	116
24	Med sand - Boulders	140
30	Med sand to fine sand	170
	Lime stone	170 T.D.

PW-37

WELL SURVEYS COMPANY

P.O. Box 583
GARDEN CITY, KANSAS 67846

[redacted]

CLOSED CIRCUIT TV DATA SHEET

Customer PEERLESS SERVICE COMPANY - 3M CORDOVA PLANT

Area Cordova, Il. Date June 15, 1994

Well No. 37 S.W.L. 59' Depth of Hole

Depth of Survey 175'

Depth & Kind of Perforations: Stainless steel wire-wrapped screen (16" or 18") 145' 175'.(TD)

Remarks: 20" steel casing. Reduces to smaller diameter (16" or 18") screen.

DESCRIPTION & REMARKS	DEPTH OF COUNTER ELECTRONIC	MECHANICAL
Top of concrete pump base	0'	
Weld	6'	
Weld	20'	
Weld	34'	
Weld	48'	
Static water level	59'	
Weld	62'	
Weld	76'	
Weld	90'	
Weld	118'	
Rub mark from bowl assembly	123'	
Swirl marks - bottom of suction pipe	135'	
Reduction - grout? on one side	144'-145'	
Into 16" or 18" wire-wrapped screen	145'	
Weld	155'	
TD of well when surveyed	175'	

PW-91

GROSCH IRRIGATION CO., INC.

Casing Type
24" Steel
24" SS
Casing Log
133' Plain
53' SS
183'

0-4 Top
4-10 med. Sand - fine gravel
10-35 fine - med Sand - Some coarse
35-41 med. Sand - fine gravel
41-45 med. sand - Some fine gravel
45-73 med. Sand - fine gravel
73-81 med. sand - Some fine gravel
81-84 med. - coarse sand - rocks
84-90 med. - coarse sand
90-100 fine sand
100-123 med. Sand
123-183 med. - coarse sand few rocks
183' Limestone

Date _____

Owner 3M Phone 309/654-2291

Contact _____ Phone _____

Address 22614 Rt 84N Cordova, IL.

Legal SW, SW, SW County Rock Island

Location Sec. 4 T20N R2E

_____ Feet From The South / North

_____ Feet From The East / West

Well #91

Permit No. _____ Pivot Dealer _____

Well Depth 183' Date Drilled 30 May 12

Perf 53' x 24" x .060 SS Plain 133' x 24" x .375" Steel

Drilling Additives 48 bags bentonite

Seal(s) Bentonite Chips (16,000 lbs) 116'-96' / Neat Cement 96'-0'

Gravel red Flint #60 yds (98,000 lbs) 183'-116'

Base chlorinated

SWL _____ Feet

_____ GPM _____ Feet

_____ GPM _____ Feet

_____ GPM _____ Feet

_____ GPM _____ Feet

_____ GPM _____ Feet

Water Sample _____ ppm

Centralizers: _____

COMMENTS: 24"

N 41° 44.680

W 90° 16.075

Test Driller _____ Date 4 June 12

Well Driller John H.

Ill[illegible]pt. of Public Health
Yellow Copy: Well Contractor
Golden Copy: Well Owner

PW-94

Well Construction Report

NEICVP1364E01

THIS FORM MUST BE COMPLETED WITHIN 30 DAYS
OF WELL COMPLETION AND SENT TO
THE ILLINOIS DEPARTMENT OF PUBLIC HEALTH
DIVISION OF ENVIRONMENTAL HEALTH
525 WEST JEFFERSON STREET
SPRINGFIELD, ILLINOIS 62761

GEOLOGICAL AND WATER SURVEYS WELL RECORD

now "3M Company Cordova PLANT"

9. Driller Joseph Driscoll License No. 092-007327
10. Well Site Address Cordova, Ill
11. Property Owner Wm. Schipper Well No.
12. Permit No. WW 04 '92 Date Issued 2-4-92
13. Location: County Rock Island
Sec. 4 5 6
Twp 20 N
Rge. 2 E

* non-potable Well for Agriculture

Show location in section plat

1. Type of Well
a. Bored____ Hole Diam. 26 in. Depth 117 ft
Buried Slab: Yes___ No___
b. Driven____ Drive Pipe Diam.____in. Depth____ft
c. Drilled ✓ Finished in Drift____ In Rock____

d. Grout:

(KIND)	FROM (Ft.)	TO (Ft.)
Bentonite	0	20

2. Well furnishes water for human consumption? Yes___ No ✓
3. Date well drilled 4-8-92
4. Permanent pump installed? Yes ___ Date_____ No___
Manufacturer_____ Type_____
Location_____
Capacity _____gpm. Depth of setting_____ft.
5. Well top sealed? Yes___ No___ Type_____
6. Pitless adapter installed? Yes___ No___
Manufacturer_____ Model No._____
How attached to casing?_____
7. Well disinfected? Yes___ No___
8. Pump and equipment disinfected Yes___ No___

14. Water from _____ at depth_____ft
to_____ft

15. Casing and Liner Pipe

Diam.(in)	Kind and Weight	From (ft)	To (ft)
14	Plain Steel	0	97
12	SS. Screen	97	117

16. Screen: Diam. 12 in, Length 20 ft. Slot Size .050
17. Size hole below casing____in. 18. Ground Elev. 6[illegible] ft msl.
19. Static level 63 ft below casing top which is 80 ft. above ground level. Pumping level 81 ft, pumping [illegible] gpm for ____ hours.

20. Earth Materials Passed Through	Depth of Top	Depth of Bottom
Top	0	2
Fine to Medium Sand	2	42
Medium to Coarse Sand	42	82
Fin to Medium Sand	82	117
Shale	117	—

Continue on separate sheet if necessary.

Signed Mike Dicks Date 4-29-92

IMPORTANT NOTICE

This State Agency is requesting disclosure of information that is necessary to accomplish the statutory purpose as outlined under Public Act 85-0863. Disclosiure of this information is mandatory. This form has been approved by the Forms Management Center.

PRESS FIRMLY WITH BLACK PEN OR TYPE
Do Not Use Felt Pen

IL482-0126

Appendix RCRA A
Page 59 of 112

3M Cordova
Cordova, Illinois

RISWCD
Rock Island County Soil & Water Conservation District

3020 East 1st Avenue
Milan, IL 61264
(309) 793-5843 Ext. 3

Standard Form 675.20

WATER USE ACT 1983
SOIL AND WATER CONSERVATION DISTRICT NOTIFICATION
OF INTENT TO DRILL A HIGH CAPACITY WATER WELL
(Please Print or Type)

Date: 10/22/2010

WELL OWNER'S NAME.....3M Cordova

ADDRESS..22614 Route 84 North

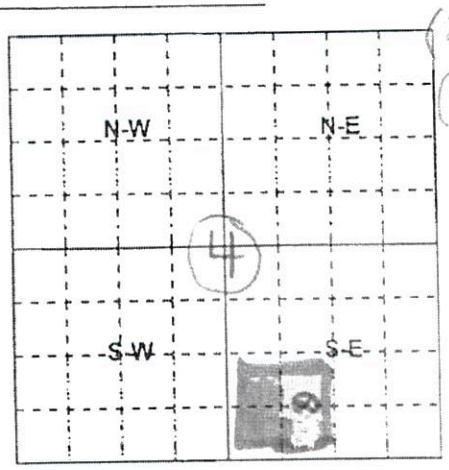
Cordova, Illinois 61242-9799

PHONE.....3096542291

LOCATION

1. Legal Description (Nearest 10 acre plot)
   a. Section 456
   b. Township (North-South) 20N
   c. Range (East-West) 2E
   d. County .....Rock Island
2. General Location Former Ken Schinner farm adj. to plant
3. Well Identification (Name or Number) ....WW 04 92

SECTION 4 (1) S E 1/4 (2) S.W. 1/4 (3) N. E 1/4



WELL CONSTRUCTION

1. WELL DEPTH (ft.) 117
2. PUMP INTAKE SETTING
   Depth of intake (ft) ..97
3. WELL SCREEN
   a. Length (ft.) 20
   b. Diameter (in.) 12
   c. Depth to bottom (ft.) .117
4. WELL CASING
   a. Diameter (in.) 14
   b. Depth to bottom (ft.) 97
5. WELL PUMP
   a. Pump Type .....Submersible
   b. Capacity (gpm) 800-1000
   c. Horse Power .....
   d. Head-rating .....
   e. Power Source .....Electricity

DRILLING CONTRACTOR

Name .....GROSCH Irrigation (Note: Well drilled in 1992)

Address ..13590 North State Route 29

Mason City, Illinois ZIP+4 62664

Phone ....(____) (217) 482-5470

State of Illinois
Department of Public Health

PW-112

Water Well Construction Report

Complete within 30 days of well completion and send to the appropriate Health Department.

1. Type of Well

a. **Driven Well**: Casing Diameter ____ in. depth ____ ft.

b. **Bored Well**: Buried Slab? [ ]

c. **Drilled Well**: PVC Casing Formation Packer set at a depth of ____ ft.

d. **Drilled Well**: Steel Casing Mechanically Driven? [ ]

e. Hole Diameter 48 in. to 178 ft.; ____ in. to ____ ft.; ____ in. to ____ ft.; ____ in. to ____ ft.;

f.

Type of Grout	# of Bags	Grout Weight	From (ft.)	To (ft.)	Tremie Depth
Neat cement		9.4	0	60	
Bentonite	2 super		60	80	

g. Well Finished within Unconsolidated Materials

h.

Kind of Gravel/Sand Pack	Grain Size/Supplier #	From (ft.)	To (ft.)
Minus 1/8	1/8	80	178

2. Well Use: Commercial

3. Date Well Completed: Oct 24, 2012 Well Disinfected? [ ] Driller's Estimated Well Yield ____ gpm

4. Date Permanent Pump Installed: Not installed yet 5. Pump Capicity: ____ gpm Set at (depth) ____ ft.

6. Pitless Adapter Model & Manufacturer: ____ Attachment to Casing: [ ]

7. Well Cap Type & Manufacturer: ____

8. Pressure Tank: Working Cycle: ____ gals. Captive Air? [ ] 9. Pump System Disinfected? [ ]

10. Name of Pump Company: ____

11. Pump Installer. ____ License # ____

12. ____ Date: ____

Licensed Pump Installation Contractor Signature

Illinois Department of Public Health
Divison of Environmental Health
525 West Jefferson Street
Springfield, IL 62761

IMPORTANT NOTICE: This state agency is requesting discolusre of information that is necessary to accomplish the statutory purpose as outlined under Public Act 85-0863. Disclosure of this Information is Mandatory. This form has been approved by the Forms Managment Center.

State of Illinois
Department of Public Health

PW-112

Water Well Construction Report

GEOLOGICAL & WATER SURVEY WELL RECORD

13. Property Owner: 3M Cordova — Well # 12

14. Driller: John Henry — License # 092-008366

15. Name of Drilling Company: Grosch Irrigation Company

16. Permit Number: 161-WW37-12 — Date Issued: Oct 12, 2012

17. Date Drilling Started: Dec 24, 2012

18. Well SITE Address: 22614 Route 84

19. Township Name: Cordova — Land I.D. #

20. Subdivision Name: — Lot #

21. Location: a. County: Rock Island

b. Township: 20N Range: 2E Section: 4

c. NE Quarter of the SE Quarter of the NE Quarter

d. GPS: Degrees 41 Minutes 45 Seconds 056 N

Degrees 090 Minutes 16 Seconds 036 W

survey use only

22. Casing and Liner Information

Diameter (in.)	Material, Joint Type	From (ft.)	To (ft.)
24	ASTM53B Steel, welded	1	128

23. Is the well screened? Yes

If yes, screen information:

Diameter (in.)	Length (ft.)	Slot Size	From (ft.)	To (ft.)
24	50	.060	128	178

24. Water from ____ at a depth of ____ ft. to ____ ft.

a. static water level ____ ft. below casing which is ____ in. above ground

b. pumping level is ____ ft. pumping ____ gpm for ____ hours

25.

Earth Materials Passed Through	From (ft.)	To (ft.)
Top soil	0	4
Medium sand to coarse gravel & rocks	4	20
Medium sand to fine gravel - few rocks	20	70
Medium sand to coarse gravel & rocks	70	80
Medium to coarse sand w/fine gravel	80	100
Fine to coarse sand w/fine to medium gravel (Bottom/Limestone)	100	178

(Attach a 2nd page, if necessary) (If DRY HOLE, fill out log & indicate how hole was sealed.)

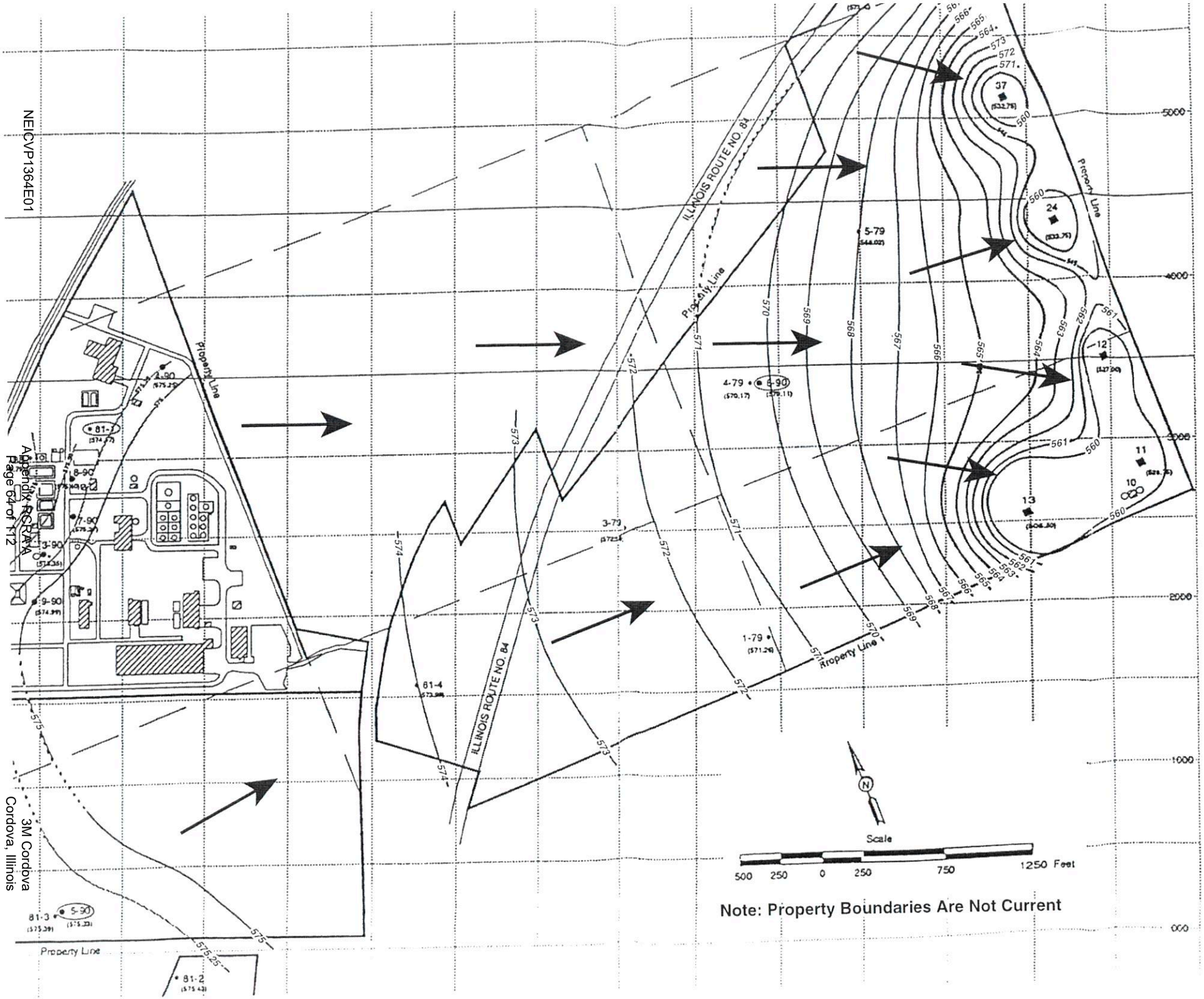
26. John Henry — Digitally signed by John Henry, DN: cn=John Henry, o=Grosch, ou, email=jgrosch@widpue.net, c=US, Date: 2012.12.18 10:18:55 -06'00' — License # 092-008366

Licensed Water Well Contractor Signature

IL 482-0126

Appendix B

Site Groundwater Contour Maps


ILLINOIS ROUTE NO. 84
Property Line
Property Line
Property Line
Property Line
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81-2
81-3
81-4
2-90
3-90
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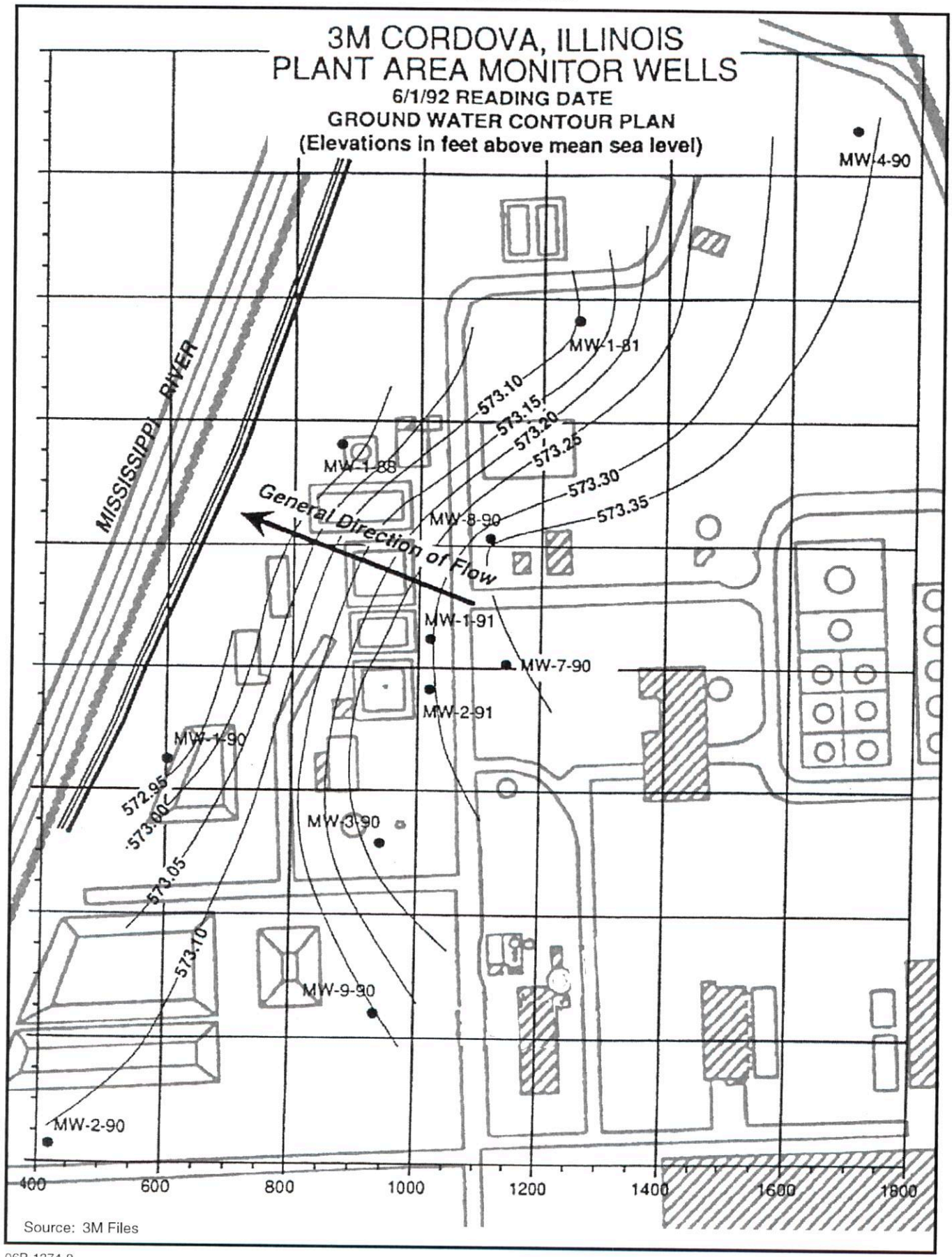
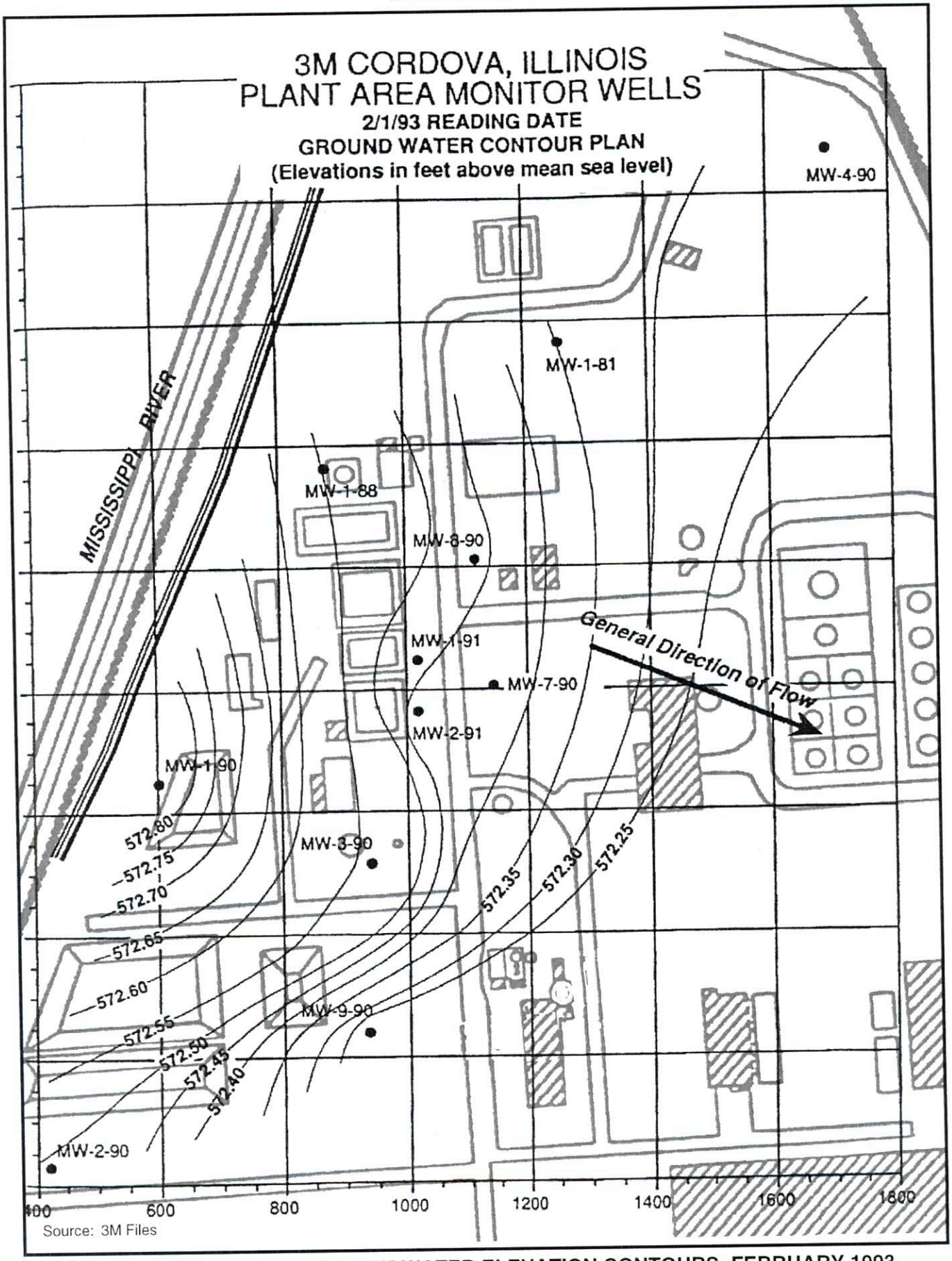
5-90
6-90
7-90
8-90
9-90
1-79
3-79
4-79
5-79
10
11
12
13
24
37
Scale
500 250 0 250 750 1250 Feet
Note: Property Boundaries Are Not Current



06P-1374-9

Figure B-2 **GROUNDWATER ELEVATION CONTOURS–JUNE 1992**
3M CORDOVA FACILITY
CORDOVA, ILLINOIS



06P-1374-10

Figure B-3 **GROUNDWATER ELEVATION CONTOURS–FEBRUARY 1993**
3M CORDOVA FACILITY
CORDOVA, ILLINOIS

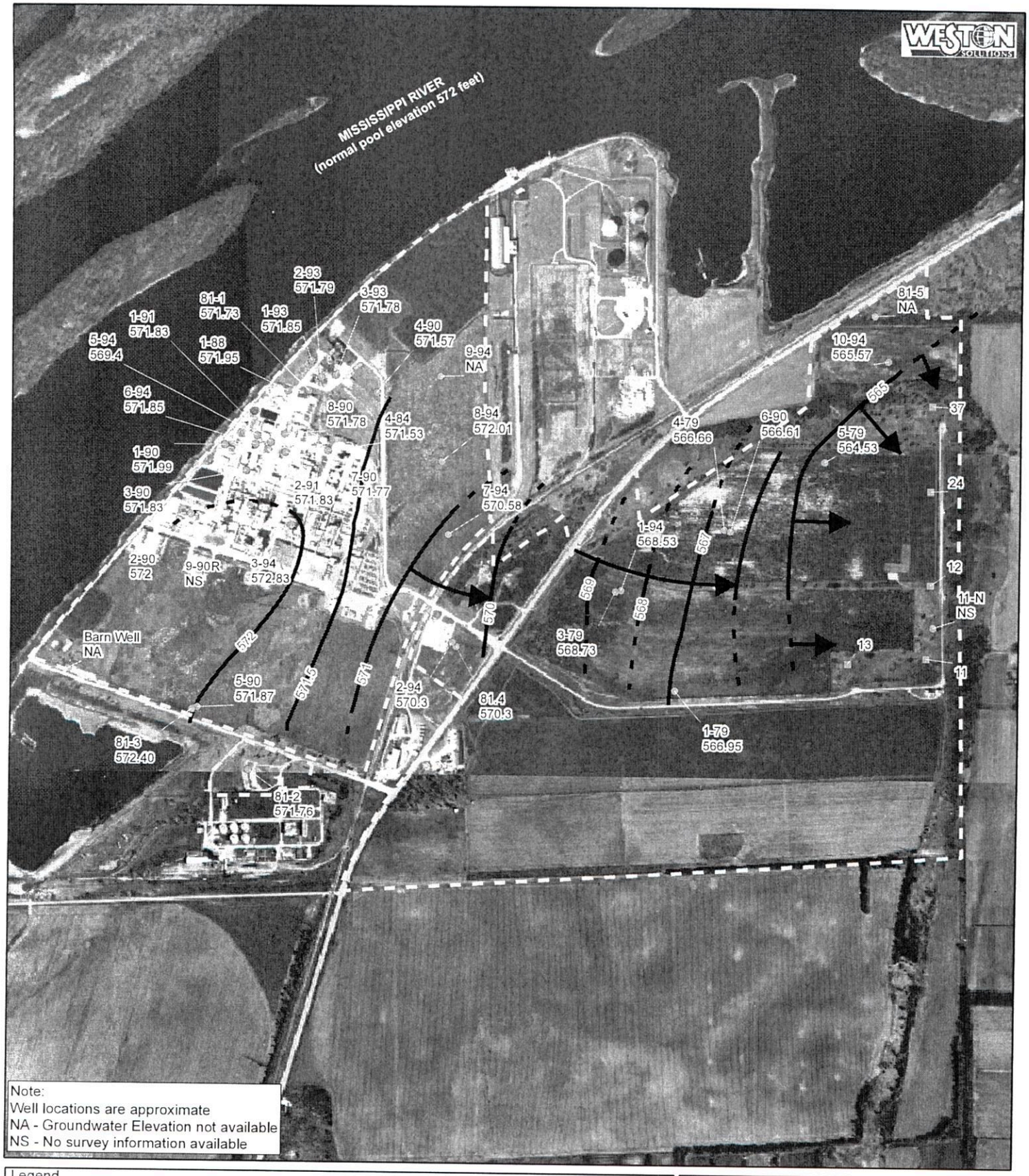
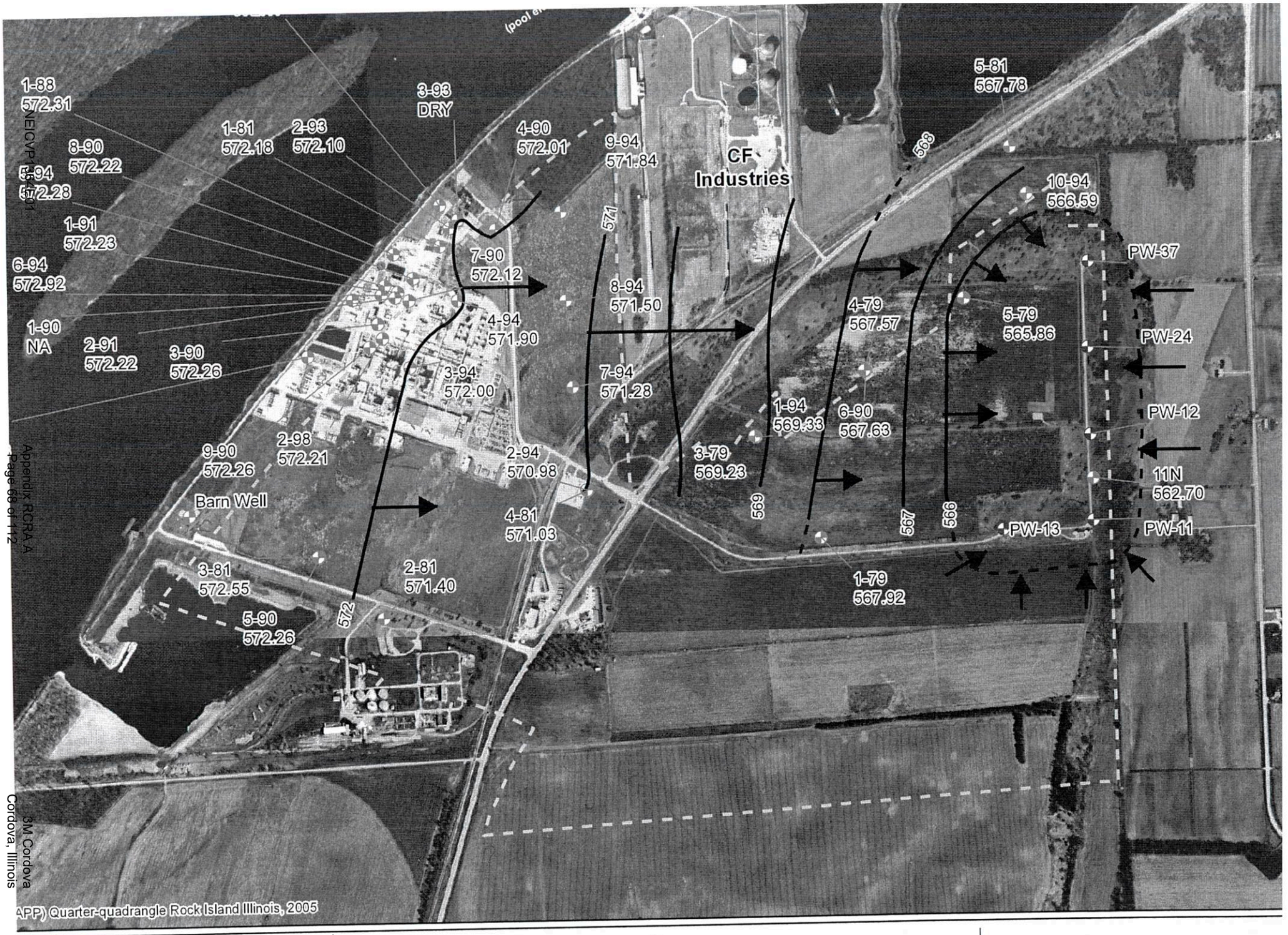


Figure B-4
Groundwater Elevation Contour Map
25 October 2006
3M Cordova Facility
Cordova, IL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Appendix RCRA A
Page 68 of 112
3M Cordova
Cordova, Illinois
APP) Quarter-quadrangle Rock Island Illinois, 2005
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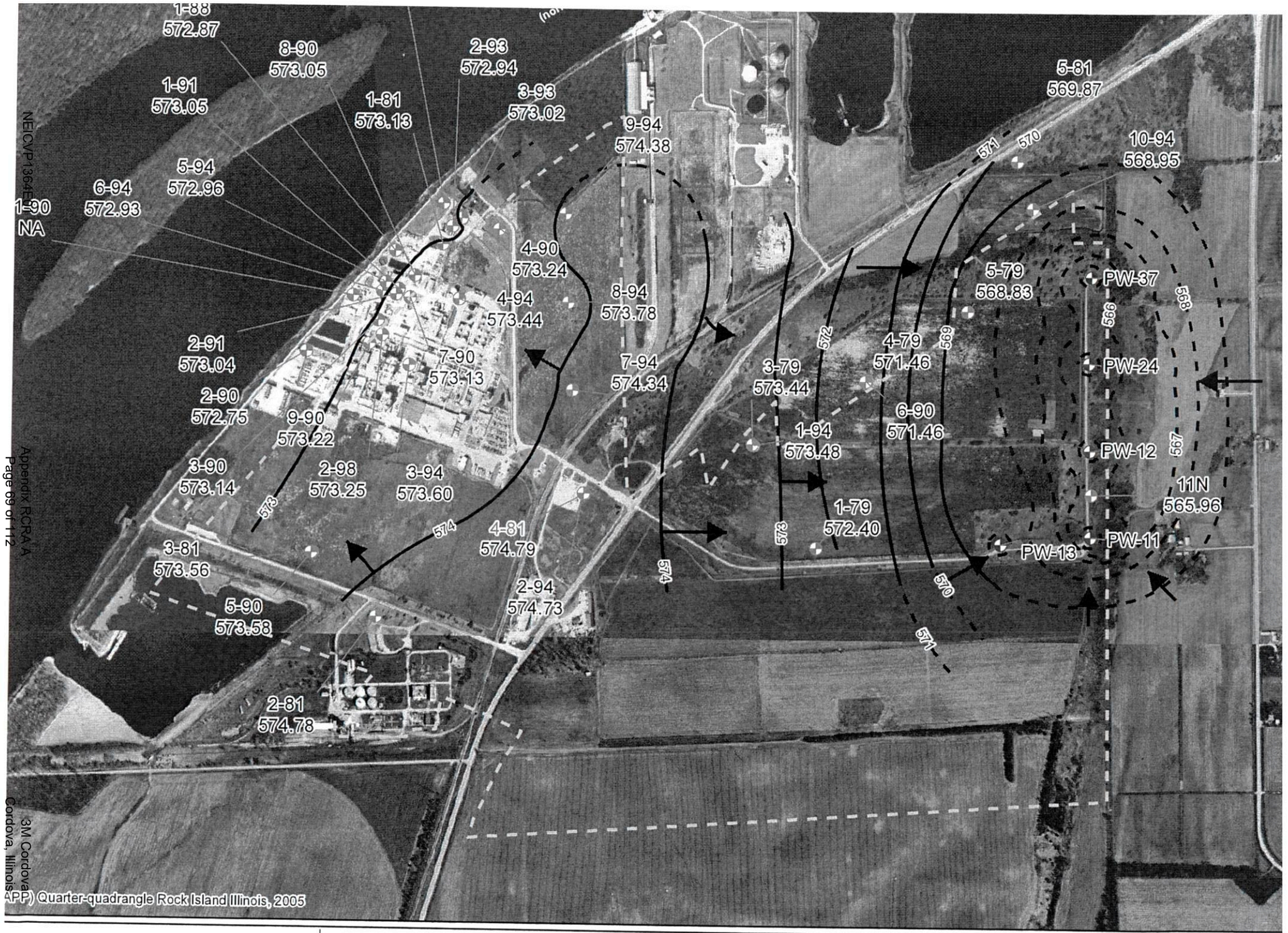
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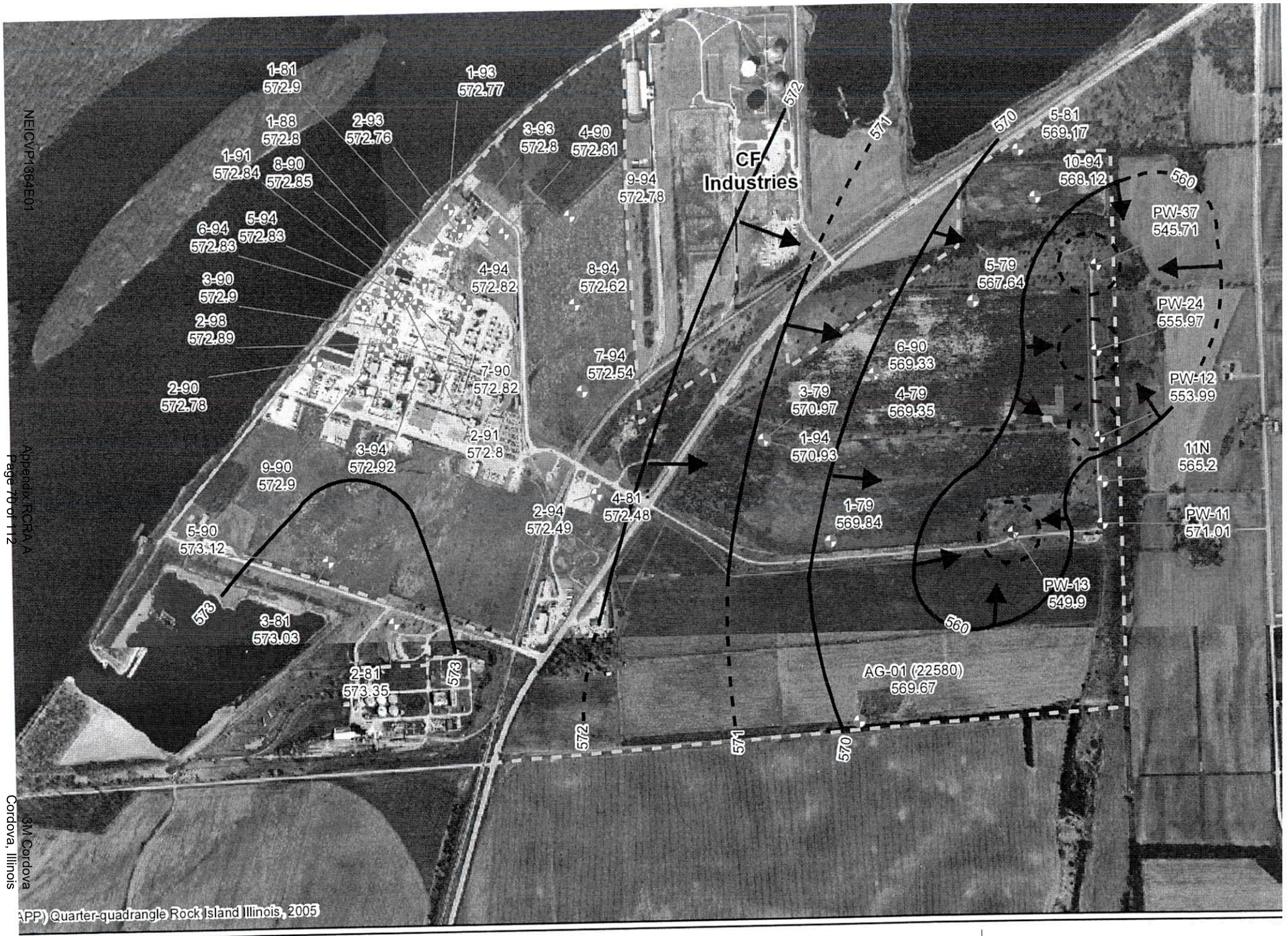
Appendix RCRA A
Page 69 of 112
3M Cordova
Cordova, Illinois
APP) Quarter-quadrangle Rock Island Illinois, 2005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Appendix RCRA A
Page 70 of 112
3M Cordova
Cordova, Illinois
APP) Quarter-quadrangle Rock Island Illinois, 2005
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3M Cordova
Cordova, Illinois

d from Mississippi River,
y Corps of Engineers,

N
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Fi
Groundwater E
Feb

from USGS monitoring station in Camanche, IA. upstream of Plant. In June 2013, river was at

N

W E

Figu
Groundwater Ele
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Appendix RCRA A
Page 74 of 112

3M Cordova
Cordova, Illinois

n USGS monitoring station in Camanche, IA.
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Groundwater E
Nov

Appendix C

IL EPA Correspondence – April 6, 2010

Baseline Remediation Objectives for Perfluorinated Chemicals – April 2, 2010

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

1021 North Grand Avenue East, P.O. Box 19276, Springfield, Illinois 62794-9276 • (217) 782-2829
James R. Thompson Center, 100 West Randolph, Suite 11-300, Chicago, IL 60601 • (312) 814-6026

PAT QUINN, GOVERNOR

DOUGLAS P. SCOTT, DIRECTOR

(217) 782-6761

April 6, 2010

CERTIFIED MAIL

7008 1830 0001 4713 1125

Minnesota Mining & Manufacturing Company (3M)
Attn: Mr. Gary A. Hohenstein
3M Center, Building 224-5W-03
St. Paul, Minnesota 55144-1000

Re: 1610150001-Rock Island County
Cordova/3M Company
22614 Route 84N
Site Remediation Program/Technical Reports

Dear Mr. Hohenstein:

The Illinois Environmental Protection Agency (Illinois EPA) has established site specific cleanup objectives or provisional objectives for several of the fluorochemicals (FC) included in the *Addendum No. 1 to the Fluorochemical (FC) Assessment Work Plan* (received April 10, 2009/ Log No. 09-40982) that was submitted for the above referenced remediation site.

Attached for your information is a table listing the site specific cleanup objectives for Perfluorooctanoic acid (PFOA), Perfluorooctane sulfonate (PFOS), and Perfluorobutanoic acid (PFBA).

At this time, the Illinois EPA's Toxicity Assessment Unit (TAU) has determined there is not enough information available to establish site specific cleanup objectives for Perfluorobutane sulfonate (PFBS) or Perfluorohexane sulfonate (PFHxS). When additional sample data is available, it will be forwarded to the TAU for further assessment and a determination.

If you have any questions regarding this letter, please contact me via e-mail at russ.irwin@illinois.gov or by telephone at (217) 524-2084.

Sincerely,

Russell H. Irwin

Russell H. Irwin, Project Manager
Bureau of Land, Division of Remediation Management
Remedial Project Management Section

Attachment: *Baseline Remediation Objectives for Perfluorinated Chemicals – April 2, 2010*

Rockford • 4302 N. Main St., Rockford, IL 61103 • (815) 987-7760
Elgin • 595 S. State, Elgin, IL 60123 • (847) 608-3131
Bureau of Land – Peoria • 7620 N. University St., Peoria, IL 61614 • (309) 693-5462
Collinsville • 2009 Mall Street, Collinsville, IL 62234 • (618) 346-5120
Des Plaines • 9511 W. Harrison St., Des Plaines, IL 60016 • (847) 294-4000
Peoria • 5415 N. University St., Peoria, IL 61614 • (309) 693-5463
Champaign • 2125 S. First St., Champaign, IL 61820 • (217) 278-5800
Marion • 2309 W. Main St., Suite 116, Marion, IL 62959 • (618) 993-7200

Baseline Remediation Objectives for Perfluorinated Chemicals – April 2, 2010

Chemical Name	Residential Values for Soil		Industrial/Commercial Values for Soil		Construction Worker Values for Soil		Soil Component of the Groundwater Ingestion Route			Baseline Groundwater Remediation Objectives		
	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)	Class I (mg/L)	Class II (mg/L)	Water ADL (mg/L)
Perfluorooctanoic Acid (PFOA)	4.9[a]	---[b]	129[a]	---[b]	39[a]	---[b]	1.9[a]	9.4	NA	0.0004	0.002	NA

a = Calculated value corresponds to a target hazard quotient of 1.0.
b = No toxicity criteria are available for this route of exposure.
NA = Not Available; no PQL or EQL available in the USEPA SW-846 analytical methods.

Chemical Name	Residential Values for Soil		Industrial Commercial Values for Soil		Construction Worker Values for Soil		Soil Component of the Groundwater Ingestion Route			Baseline Groundwater Remediation Objectives		
	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)	Class I (mg/L)	Class II (mg/L)	Water ADL (mg/L)
Perfluorooctane Sulfonate (PFOS)	2[a]	---[b]	53[a]	---[b]	16[a]	---[b]	0.0041[a]	0.0041	NA	0.0002	0.0002	NA

a = Calculated value corresponds to a target hazard quotient of 1.0
b = No toxicity criteria are available for this route of exposure.
NA = Not Available; no PQL or EQL available in the USEPA SW-846 analytical methods.

Chemical Name	Residential Values for Soil		Industrial/Commercial Values for Soil		Construction Worker Values for Soil		Soil Component of the Groundwater Ingestion Route			Baseline Groundwater Remediation Objectives		
	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)	Class I (mg/L)	Class II (mg/L)	Water ADL (mg/L)
Perfluorobutanoic Acid (PFBA)	230[a]	3200[b]	5900[a]	3200[b]	590[a]	3200[b]	0.16[a]	0.16	NA	0.02	0.02	NA

a = Calculated value corresponds to a target hazard quotient of 1.0.
b = Soil Saturation Limit.
NA = Not Available; no PQL or EQL available in the USEPA SW-846 analytical methods.

Appendix D

U.S. EPA Fact Sheet

PFC Contamination of Biosolids Near Decatur, Alabama - March 2011

U.S. Environmental Protection Agency
FACT SHEET

Perfluorochemical (PFC) Contamination of Biosolids Near Decatur, Alabama

March 2011

Introduction:

The Region 4 Office of the U.S. Environmental Protection Agency (EPA) is distributing this fact sheet to provide information to the public regarding selected perfluorochemicals (PFCs) found in treated sewage sludge (biosolids) from the Decatur Utilities Dry Creek Waste Water Treatment Plant (Decatur Utilities) in Decatur, Alabama. For 12 years (1996 to 2008), biosolids from Decatur Utilities were used as a soil amendment on about 5000 acres of privately owned agricultural fields in Alabama's Lawrence, Morgan and Limestone counties. EPA is coordinating with the Alabama Department of Environmental Management (ADEM), U.S. Department of Agriculture (USDA), U.S. Food and Drug Administration (FDA), Agency for Toxic Substances and Disease Registry (ATSDR), Decatur Utilities and local industries to investigate the release of PFCs to the environment that may have resulted from the application of biosolids.

Background:

EPA regulations under the Clean Water Act allow biosolids to be land applied as a soil amendment and fertilizer as long as certain monitoring requirements for regulated chemicals are performed and standard operating regulations are followed. PFCs are a class of man-made chemicals that, in most cases, are not regulated by EPA. Therefore, the testing of biosolids for these chemicals is typically not required. In January 2009, EPA developed drinking water provisional health advisory levels for two PFCs: perfluorooctanoic acid (PFOA) and perfluorooctyl sulfonate (PFOS). The provisional health advisory level for PFOA is 0.4 parts per billion (ppb) [micrograms per liter] and the provisional advisory level for PFOS is 0.2 ppb.

PFCs are used in a variety of industrial and consumer applications and products, including fire-fighting foams; personal care and cleaning products; and oil, stain, grease, and water repellent coatings on carpet, textiles, leather, and paper. Several industries in the Decatur area manufacture PFCs or use them as part of their manufacturing processes.

Decatur Utilities receives wastewater from municipal (i.e., residential) as well as industrial sources, including local facilities that utilize PFCs in their manufacturing processes. In 2007, one of the Decatur PFC manufacturers notified EPA that it had unknowingly discharged PFCs to Decatur Utilities. This notification led EPA to initiate an investigation to determine if the biosolids from Decatur Utilities were contaminated, and if the land application of these biosolids had resulted in the potential release of PFCs to the environment.

In October 2008, EPA received analytical results from its Office of Research and Development (ORD) for a limited set of soil and sludge samples collected from two agricultural sites where biosolids from Decatur Utilities had been applied. The analytical results from biosolids samples collected from the Decatur Utilities facility were also reported. The results indicated relatively elevated levels of PFOA, PFOS and other PFCs when compared with other environmental sampling results from industrial and non-industrial (e.g., residential) sites. The limited screening data from the soil sampling sites showed PFOS ranging from 589 to1296 ppb and PFOA ranging from 55 to 2531 ppb in the nine soil samples analyzed by the EPA ORD.

After learning of these levels of PFCs in its biosolids, Decatur Utilities made the decision to cease land application of biosolids in November 2008.

Upon receiving the screening study results, EPA planned and conducted a series of follow-up targeted monitoring studies from November 2008 - February 2009. Three studies have been conducted to date by EPA to sample and analyze for PFCs in the area where biosolids were applied, specifically looking at: 1) public drinking water systems; 2) groundwater and surface waters; and 3) soils. In addition, a group of local industries (Decatur Utilities, 3M, Daikin, and Toray) completed a comprehensive private well survey in the areas surrounding the land application sites.

The first follow-up study was designed to see if PFCs were present in the Decatur area public drinking water systems. The analyses of samples collected by EPA and ADEM from the public water supply systems in Morgan and Lawrence counties in November 2008 found no detectable concentrations of PFCs in two of the three public water systems (Moulton and Decatur). The levels of PFCs detected in the West Morgan/East Lawrence system were below EPA's provisional health advisory levels of 0.4 ppb for PFOA and 0.2 ppb for PFOS in drinking water. In September 2009, EPA expanded its public water sampling event to include the public water systems of Limestone County and the Swann Creek Community. The sample results from the five public water systems sampled in September 2009 were below EPA's provisional health advisory levels.

The second study looked for PFCs in private water wells, ponds, and surface waters located near the land application areas. Between January and March 2009, EPA collected and analyzed samples from 18 private water wells adjacent to the land application sites. Water samples were also collected from 32 ponds and from one stream in or near the fields that received the highest applications of biosolids. The final report indicated the following results:

- None of the six private drinking water wells sampled had levels above the PFOS provisional health advisory levels, while two of the wells sampled had PFOA levels above EPA's provisional health advisory level. These two wells had PFOA levels of 2.2 ppb and 0.6 ppb respectively. Both of these residences with elevated PFOA levels were quickly provided with bottled water and connected to the public water supply system by Decatur Utilities and the group of local industries.
- The final ground water sampling results from the 12 other non-potable private wells for PFOA ranged from no detectable levels to 6.41 ppb and for PFOS ranged from no detectable levels to 0.15 ppb.
- The final surface water sampling results from 32 ponds and one stream for PFOA ranged from no detectable levels to 11.0 ppb, and for PFOS ranged from no detectable levels to 0.08 ppb.

The third study was designed to better understand if the land application of Decatur biosolids had resulted in the PFC contamination of the soils throughout the land application areas. In March 2009, 32 soil samples in or near the fields with the highest applications of biosolids were collected and analyzed. The final report indicated the following results:

- For PFOA, the results ranged from below the limit of quantization up to 317 ppb.
- For PFOS, the results ranged from below the limit of quantization up to 408 ppb.

In response to the detection of PFOA and PFOS in biosolids-applied soils, EPA released (in October 2009) residential soil screening guidance values for PFOA and PFOS that are protective of children who might incidentally ingest soils during play. These soil screening values are 16,000 ppb for PFOA and 6,000 ppb for PFOS. None of soil samples collected by EPA in 2007 or 2009 exceeded the soil screening values for protection of children's health (which are also protective of adult health).

In May 2009, USDA sampled blood and tissue from selected cows/steers from farms where Decatur Utilities biosolids were land applied in the past. Samples from seven animals associated with "high" application fields and two animals from "minimally" applied fields were collected. The final analytical results from these tests indicate the values are below USDA's minimum proficiency level (MPL) of 20 ppb for both PFOS and PFOA. Therefore, these samples are reported as not detectable for PFOS and PFOA. Based on USDA estimates for human health concerns using the MPL as an upper limit value and current Decatur area exposure patterns, this testing supports USDA's finding that there is no reason to believe there are human health concerns with consuming the meat processed from cattle grazed on lands receiving these biosolids.

Also in May 2009, FDA sampled and analyzed two milk samples for PFOA and PFOS. One sample was collected from a single cow and the other sample collected from a bulk milk tank from a dairy farm located in the Decatur area that received limited application of Decatur Utilities biosolids. FDA testing found no PFOA or PFOS in the milk sample from the single cow. A very low level (0.17 ppb) of PFOS was detected in the bulk tank milk sample. FDA is currently testing retail milk samples collected throughout the U.S. for PFOA and PFOS to obtain additional information on background levels for PFCs in milk. To date, FDA testing found no PFOA in any of the 18 retail milk samples tested. A very low level of PFOS (0.042 ppb) was detected in one retail milk sample.

In August 2009, at the request of EPA, Decatur Utilities and the group of local industries conducted a comprehensive survey to identify any additional private drinking water wells located up to one mile from the biosolids application sites. Twelve wells were identified and a sampling plan was developed. The sample results from this August 2009 study indicated that none of the wells have PFOA or PFOS levels above EPA's drinking water provisional health advisory. The final sampling report indicated the following results:

- For PFOA, the results ranged from no detectable levels up to 0.061 ppb.
- For PFOS, the results ranged from no detectable levels up 0.067 ppb.

In February and March 2010, the group of local industries continued their sampling protocol. In accordance with the sampling plan and, based on the results of the first sampling analyses, the industries sampled seven of the twelve initial drinking wells. The final sampling report from this second set of samples indicated that one of these seven drinking water wells had PFOS levels of 0.339 ppb and 0.365 ppb (duplicate sample) values above EPA's provisional health advisory. The residence with elevated PFOS levels was quickly provided with bottle water and connected to the public water supply system by Decatur Utilities and the group of local industries. The final sampling report indicated the following results:

- For PFOA, the results ranged from 0.0285 ppb up to 0.122 ppb.
- For PFOS, the results ranged from no detectable levels up to 0.365 ppb

In May 2010, the group of local industries conducted the third drinking water well sampling event in accordance with their sampling protocol. The final sampling report from this third set of samples indicated none of the six private drinking water wells sampled had PFOA or PFOS values above EPA's provisional health advisory. The final sampling report indicated the following results:

- For PFOA, the results ranged from no detectable levels up to 0.0398 ppb.
- For PFOS, the results ranged from 0.0100 ppb up to 0.0691 ppb.

In August 2010, the group of local industries conducted the fourth drinking water well sampling event in accordance with their sampling protocol. The final sampling report from this fourth set of samples indicated none of the six private drinking water wells sampled had PFOA or PFOS values above EPA's provisional health advisory. The final sampling report indicated the following results:

- For PFOA, the results ranged from no detectable levels up to 0.0524 ppb.
- For PFOS, the results ranged from no detectable levels up to 0.156 ppb.

Industries in the Decatur area have made significant progress over the last few years to reduce and prevent the release of PFCs to the environment. The industries have stopped manufacturing PFOS and are currently phasing out PFOA. Investigations have been ongoing to identify industrial and domestic sources of PFCs to the wastewater treatment plant. Ultimately, the goal is to eliminate or reduce the intake and output of these contaminants to levels that will not impact public health or the environment.

In April 2010, ATSDR, in collaboration with EPA, voluntarily sampled and tested the blood of 155 residents in the Decatur area to determine the concentration of PFOA, PFOS and other PFCs in their blood. The testing was free to qualified participants and the individual's results will be kept. Participants received no other medical tests, diagnosis, or treatment. The ATSDR investigation targeted residents who have potentially been exposed to PFCs released by the biosolids-applied soils or from water sources containing PFCs. Eligible residents received a letter from the ATSDR inviting them to participate in the investigation. In February 2011, each participant received the test results of their respective PFC blood levels and was invited to meet with an ATSDR toxicologist to discuss their individual blood test results. Participants were informed on whether their test results indicated PFC levels below or above the average of most people in the United States population as referenced in the Centers for Disease Control and Prevention (CDC) National Health and Nutritional Examination Survey (NHANES) for PFOA and PFOS. The ATSDR plans to publish the final summary report in 2011.

Scientists do not definitively know how PFC concentrations in the blood can affect a person's health, and until more research is completed, it is not possible to know:

- If the PFC levels in a person's blood will make the person sick now or later in life;
- If a person's current health problems are related to the PFC levels found in their body; or
- How or from where the PFCs entered their body.

Because of the wide spread use of PFCs, most people in the United States have some concentration of PFCs in their body. Once the PFCs are in a person's body, it takes several years for the level in the body to be reduced by one-half the initial level, even if no further exposures to PFCs occur. There is still much to learn about the health effects associated with PFCs. Some studies suggest that lower birth weight, increased cholesterol, and changes in liver function may be associated with exposures to PFCs. Yet, other studies have not shown the same associations. Therefore, there is still much debate about how exposures to PFCs may affect humans. Because many factors can contribute to health problems, it is difficult to link a person's health problem directly to any single measurement of PFCs in the blood. Testing of a person's PFC blood concentrations can be used to determine if exposures have occurred; however, these measurements do not tell the timing, magnitude, or duration of exposure.

Additional Information:

Information on PFC contamination of biosolids applied near Decatur, Alabama and other related topics are available at the EPA Region 4 website:

http://www.epa.gov/region4/water/PFCindex.html

The environmental samples associated with the Decatur Utilities biosolids contain other PFCs for which EPA has not issued drinking water and residential advisory levels. EPA is currently working to establish a threshold value for PFCs, including PFOA and PFOS, in biosolids to protect public health through all exposure pathways, but has not yet completed this ongoing work. Therefore, it is not currently known if the levels of PFOA, PFOS and other PFCs in Decatur Utilities biosolids are protective of public health. EPA has not established guidance levels for PFCs, including PFOA or PFOS, in wastewater effluent, sewage sludge, compost, groundwater or surface water as it has for drinking water and residential soil.

If persons are concerned about PFC compounds in their drinking water, some water filtration devices (point-of-use devices that are installed at an individual tap, faucet, or outlet) may remove some of these compounds from water, based on a study conducted by the Minnesota Department of Health. Individuals should contact the company that makes the water filtration device to determine whether the device is effective in removing PFC compounds, and ask for advice on how often they should change their filters.

Contact Information:

Connie Roberts
Special Assistant to the Director
Water Protection Division
EPA Region 4
61 Forsyth Street
Atlanta, Georgia 30303
Phone: 404-562-9406
roberts.connie@epa.gov

CAPT Bruce Tierney, M.D.
U.S. Public Health Service
Exposure Investigations Section
Agency for Toxic Substances and Disease Registry
Centers for Disease Control and Prevention
4770 Buford Highway, NE Mailstop F-59
Atlanta, Georgia 30341-3717
Phone: 1-888-529-1906 or 770-488-0771
bgt2@cdc.gov

Appendix E

Mississippi River Surface Water PFC Results

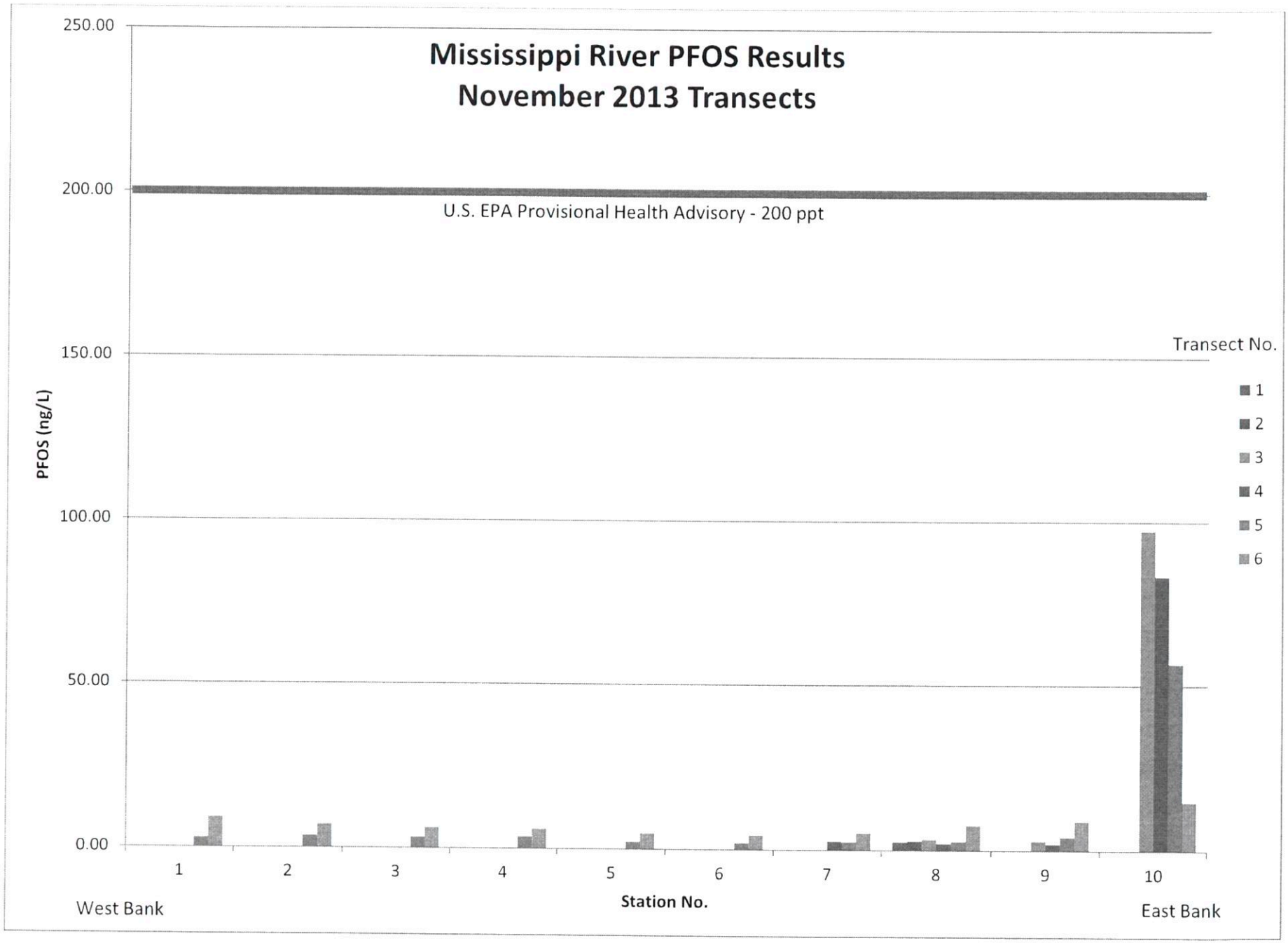
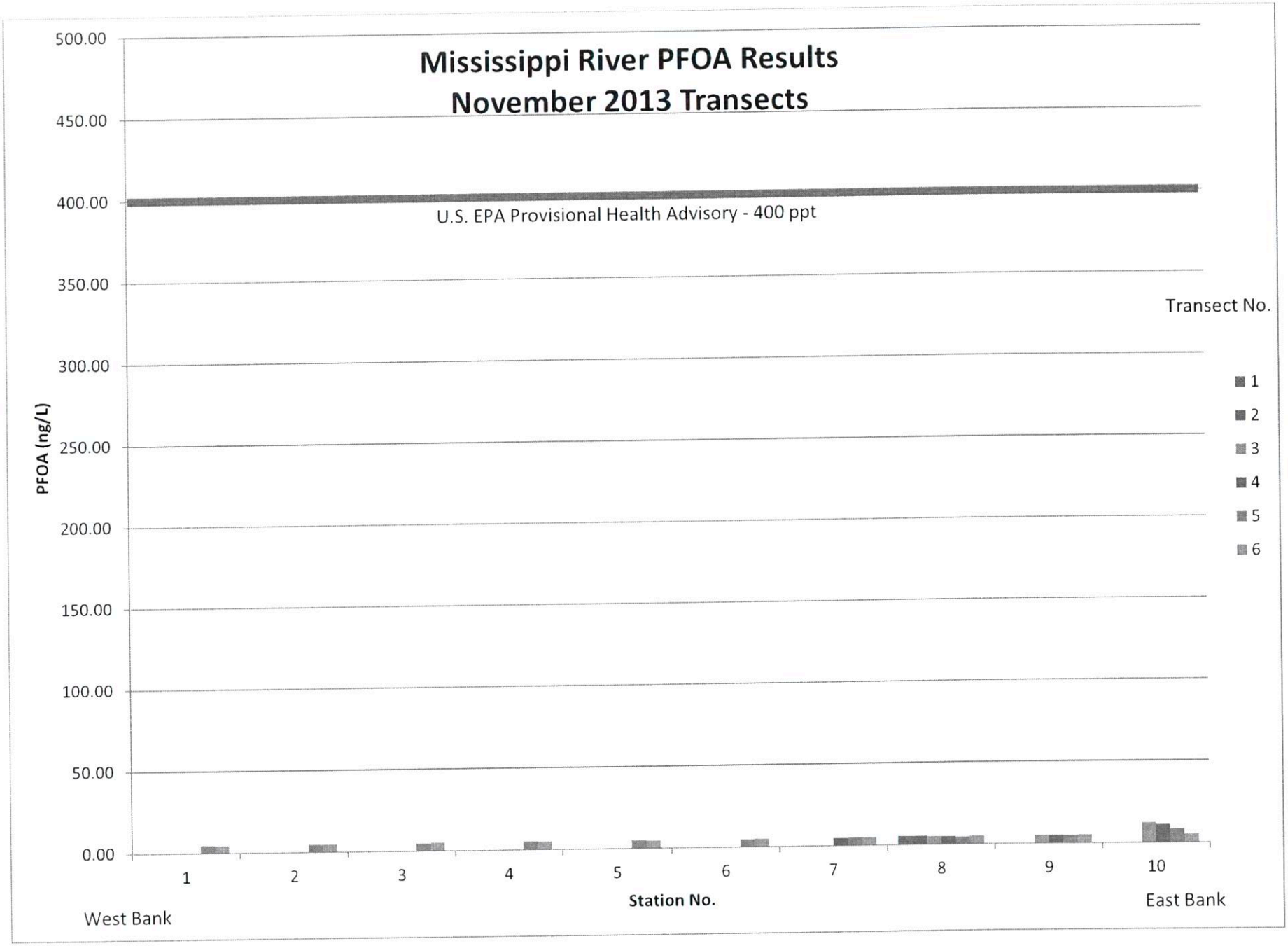

Mississippi River PFOS Results
November 2013 Transects
250.00
200.00
150.00
100.00
50.00
0.00
U.S. EPA Provisional Health Advisory - 200 ppt
PFOS (ng/L)
Transect No.
1
2
3
4
5
6
1
2
3
4
5
6
7
8
9
10
Station No.
West Bank
East Bank

Figure E-1


Mississippi River PFOA Results
November 2013 Transects
U.S. EPA Provisional Health Advisory - 400 ppt
PFOA (ng/L)
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450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
Transect No.
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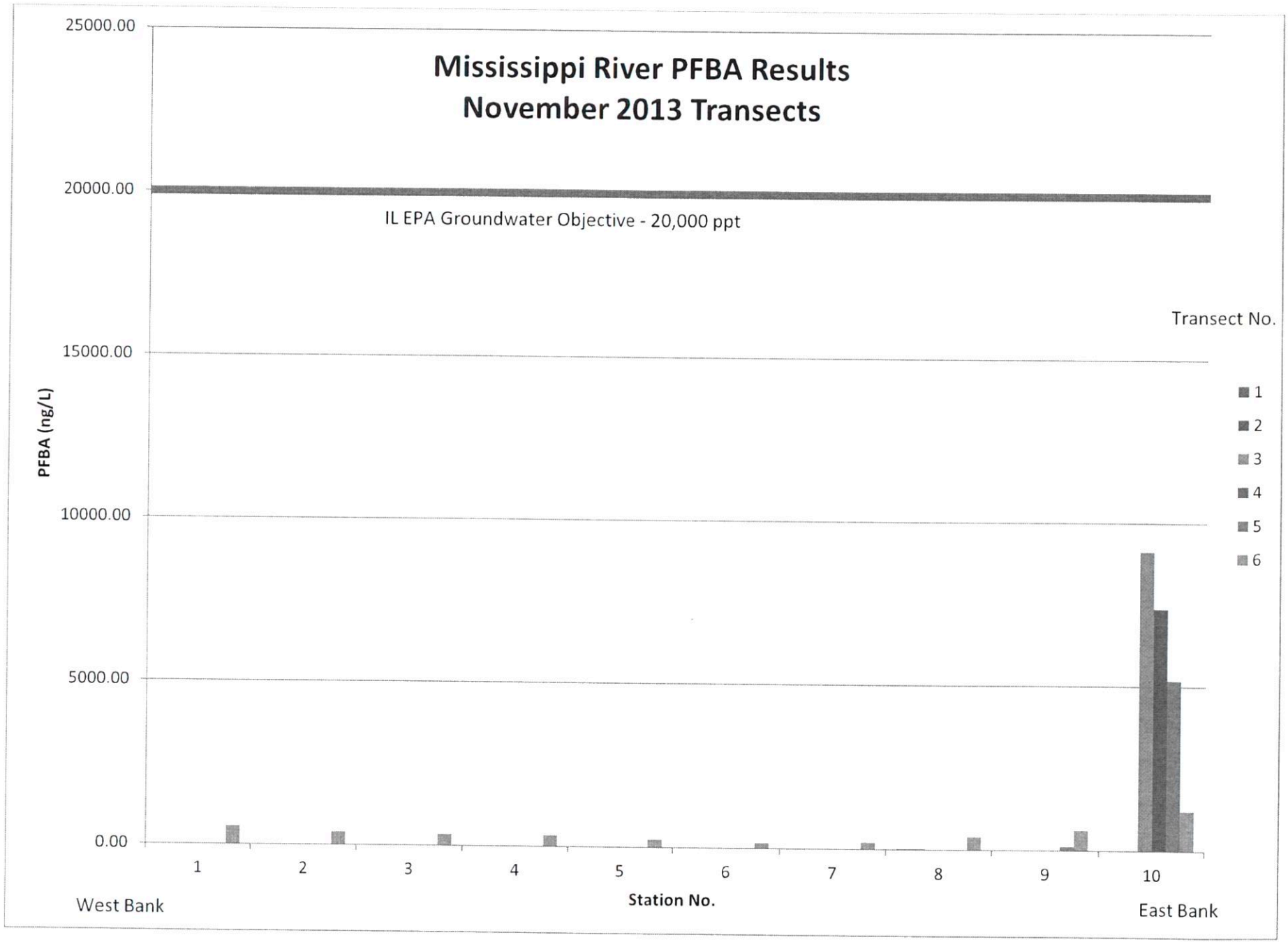
Station No.
West Bank
East Bank

Figure E-2


Mississippi River PFBA Results
November 2013 Transects
25000.00
20000.00
15000.00
10000.00
5000.00
0.00
IL EPA Groundwater Objective - 20,000 ppt
PFBA (ng/L)
Transect No.
1
2
3
4
5
6
1
2
3
4
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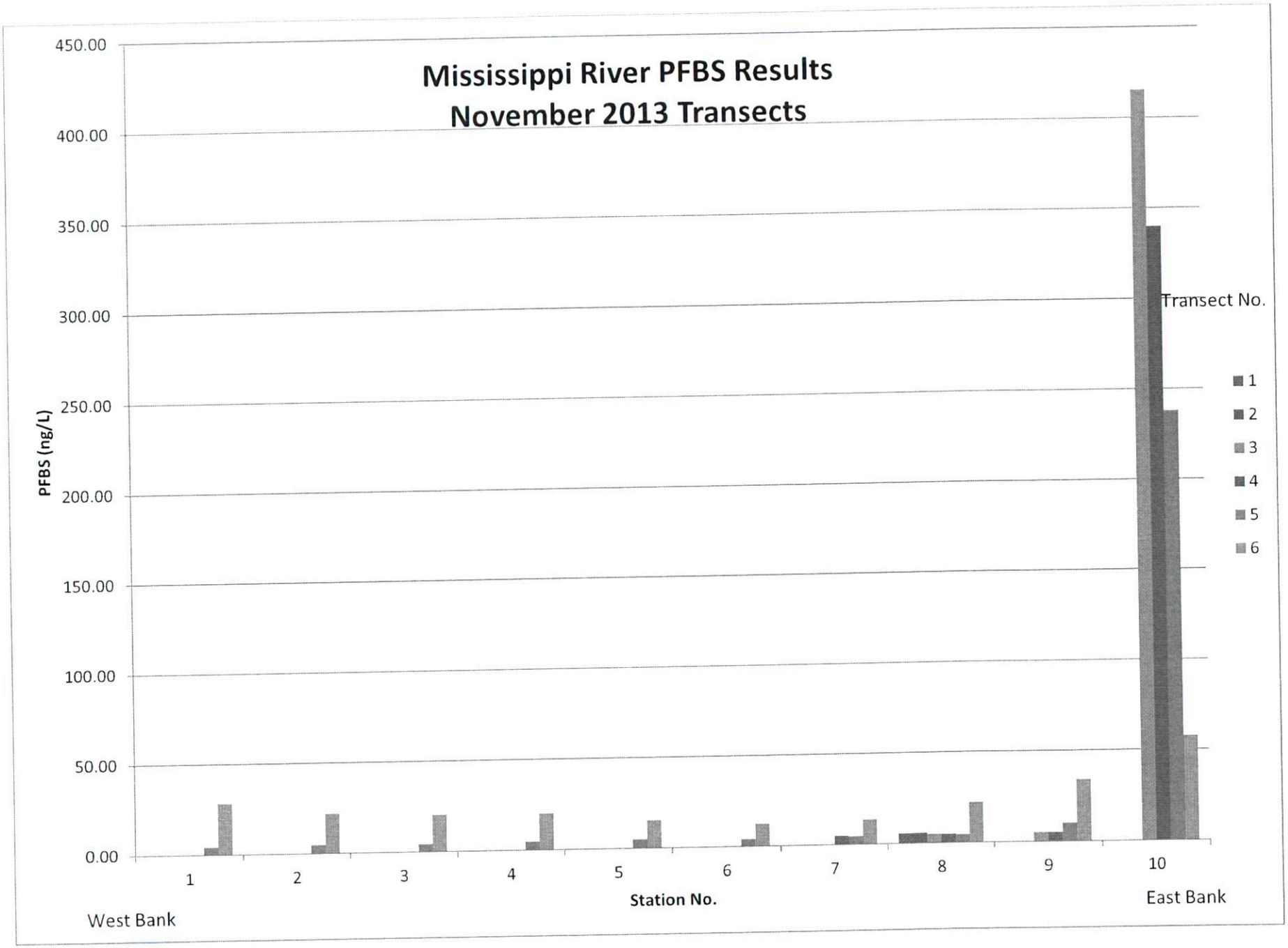
9
10
Station No.
West Bank
East Bank

Figure E-3


Mississippi River PFBS Results
November 2013 Transects
PFBS (ng/L)
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
Transect No.
1
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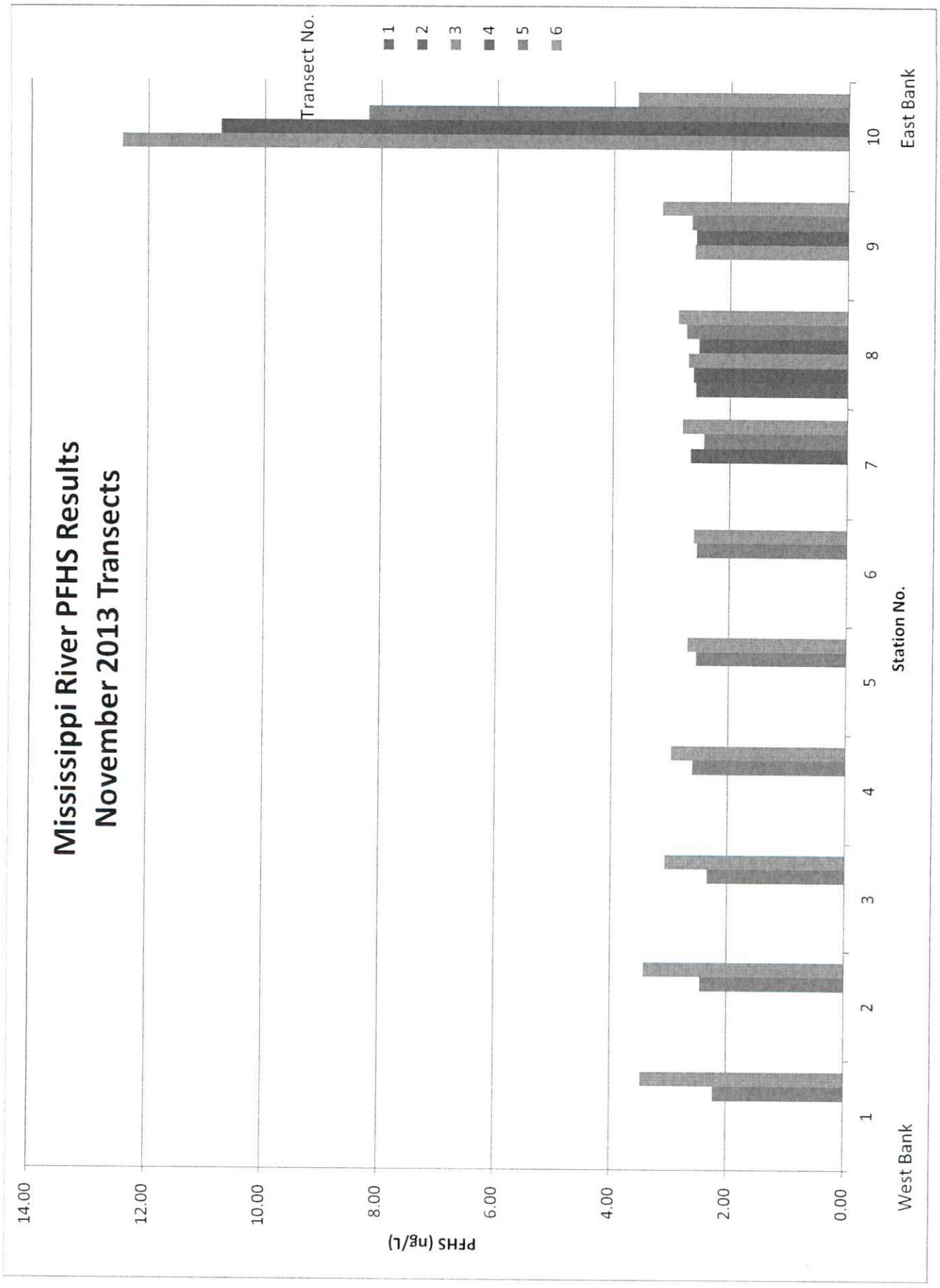
Station No.
West Bank
East Bank

Figure E-4


Mississippi River PFHS Results
November 2013 Transects
Transect No.
1
2
3
4
5
6
PFHS (ng/L)
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
West Bank
East Bank
Station No.
1
2
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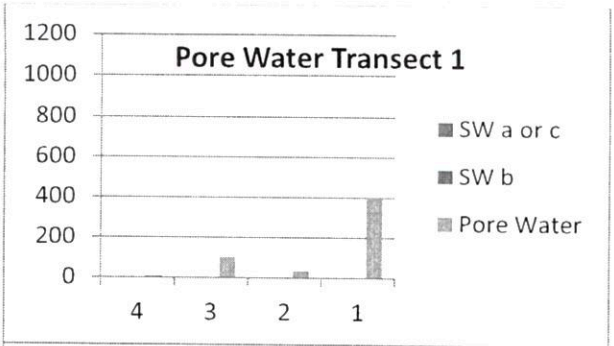
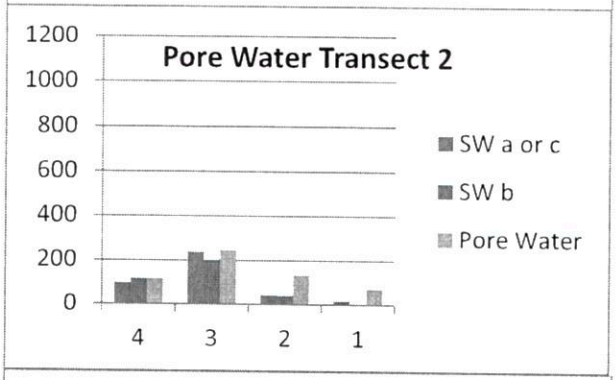
5
6
7
8
9
10

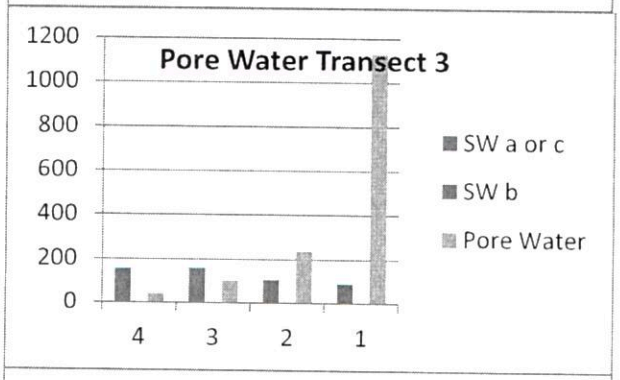
Figure E-5

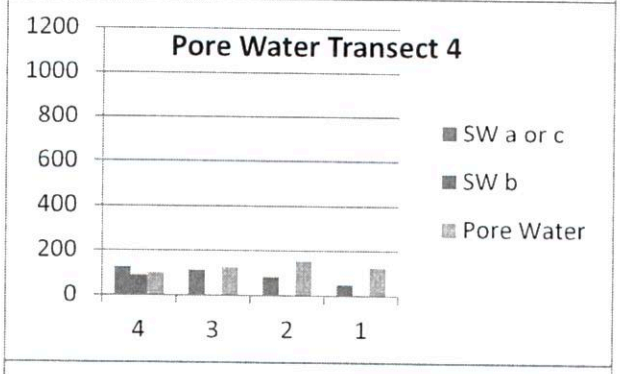
Appendix F

Mississippi River Pore Water PFC Results









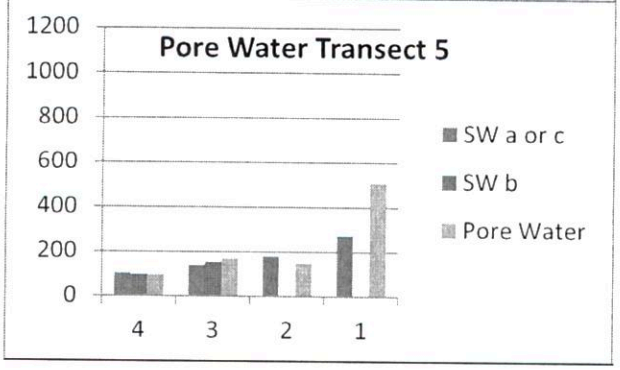


Figure F-1

Pore Water Transects – PFOS Results

All results in ng/L (ppt)

SW – surface water

a, b, c – different sampling depths

Location 4 – furthest west

Location 1 – furthest east (next to shore)

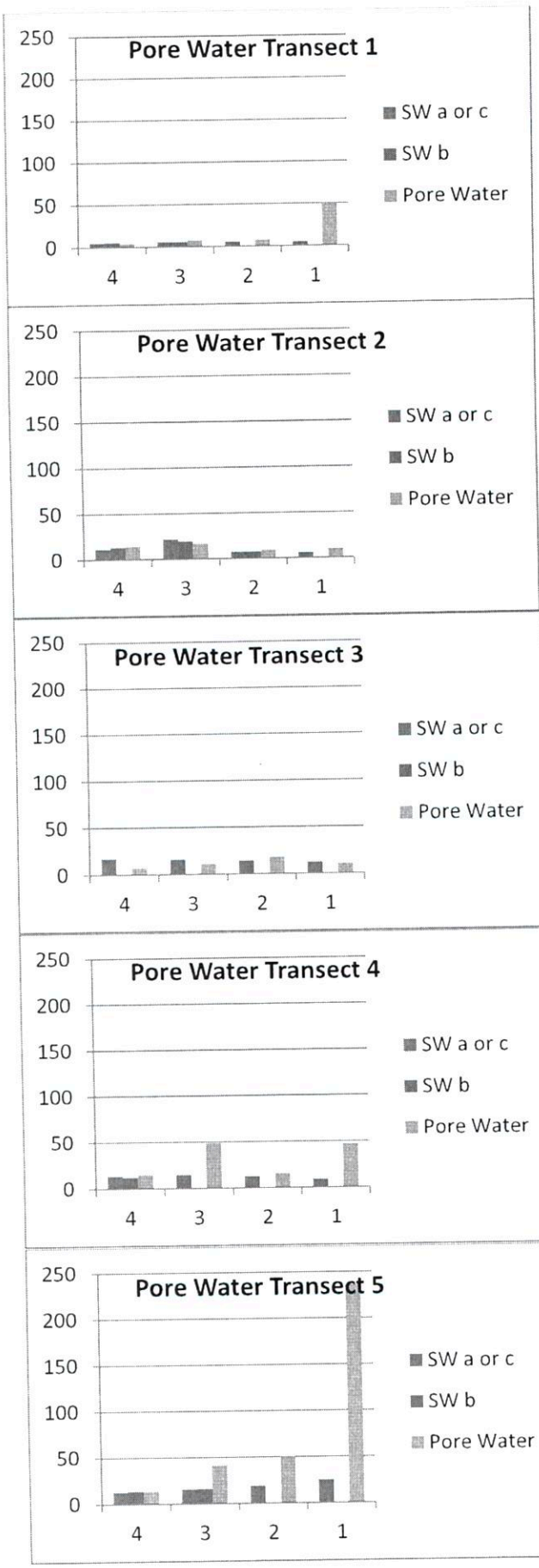


Figure F-2

Pore Water Transects – PFOA Results

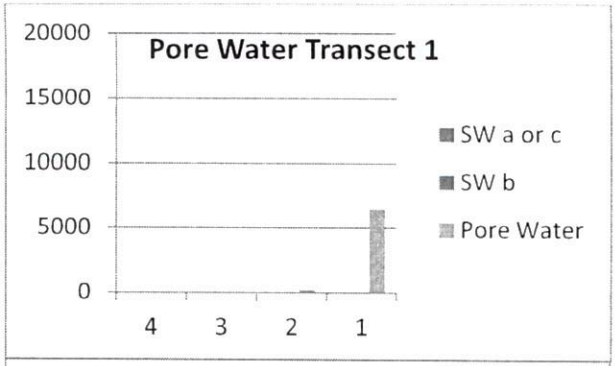
All results in ng/L (ppt)

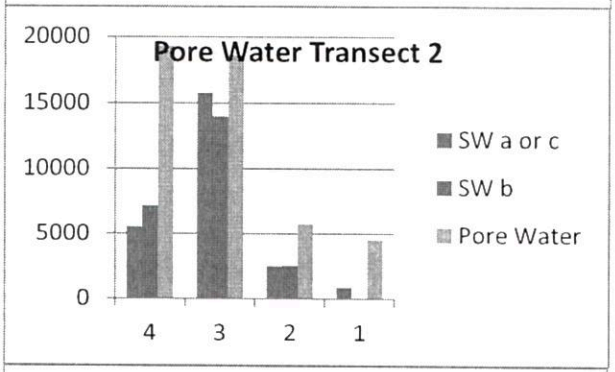
SW – surface water

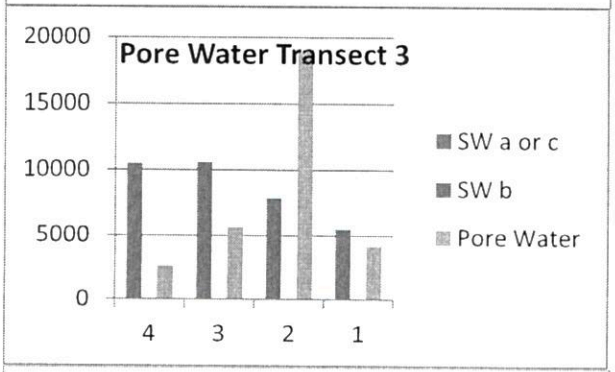
a, b, c – different sampling depths

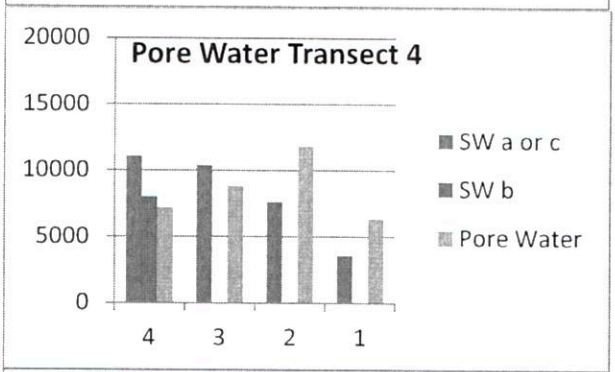
Location 4 – furthest west

Location 1 – furthest east (next to shore)









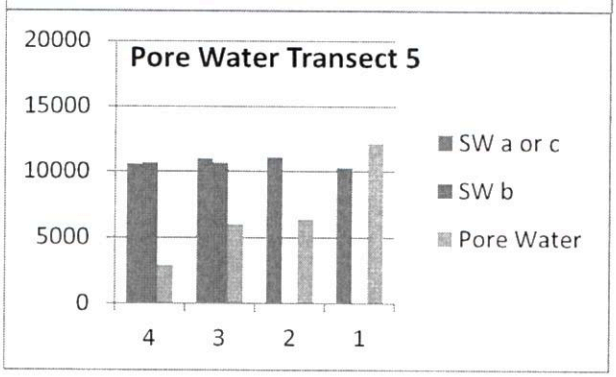


Figure F-3

Pore Water Transects – PFBA Results

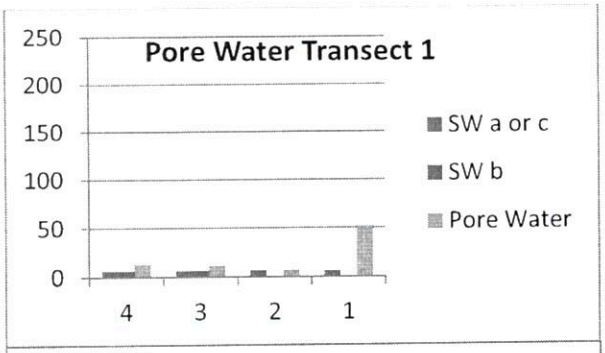
All results in ng/L (ppt)

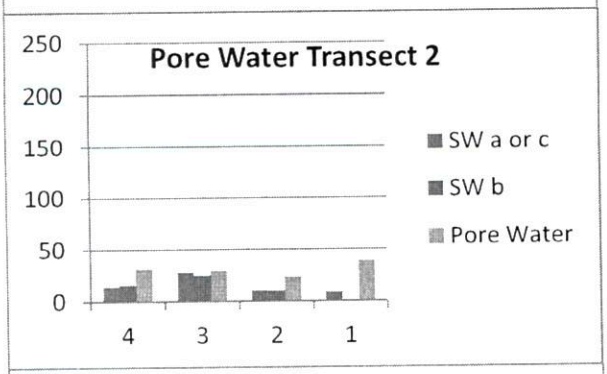
SW – surface water

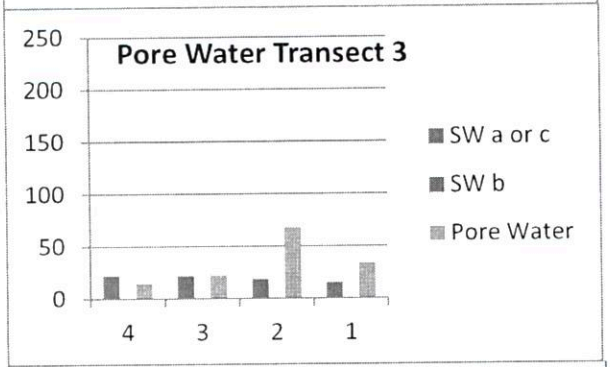
a, b, c – different sampling depths

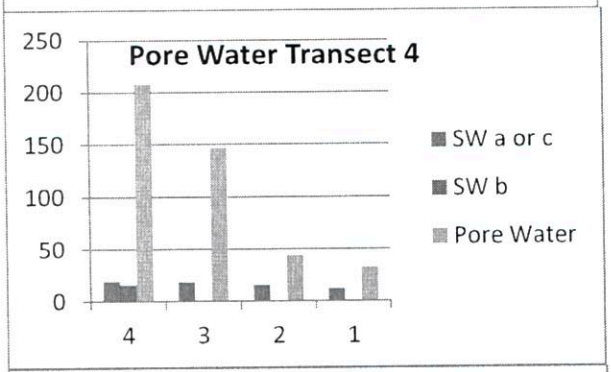
Location 4 – furthest west

Location 1 – furthest east (next to shore)









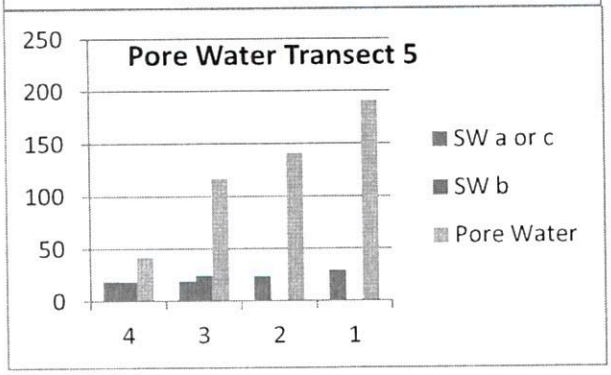


Figure F-4

Pore Water Transects – PFBS Results

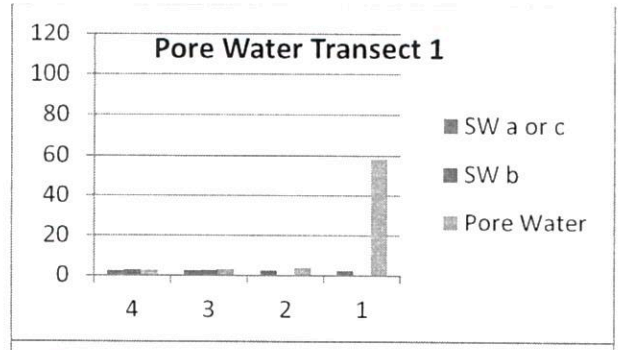
All results in ng/L (ppt)

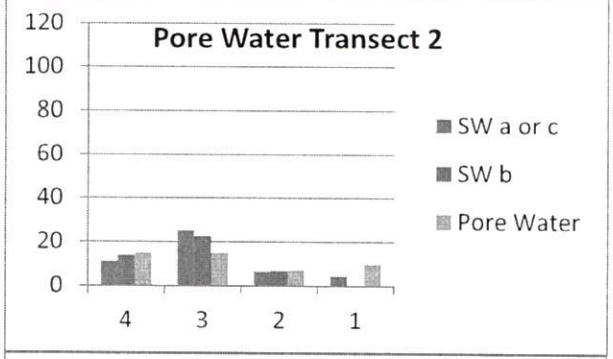
SW – surface water

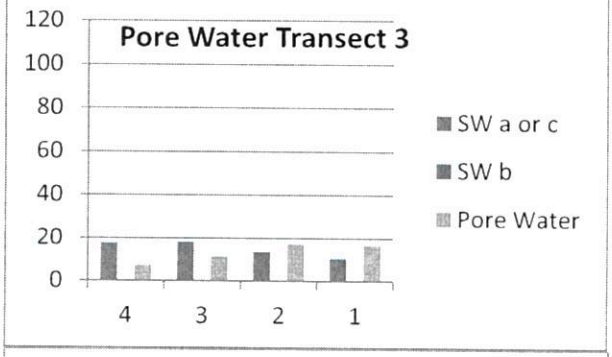
a, b, c – different sampling depths

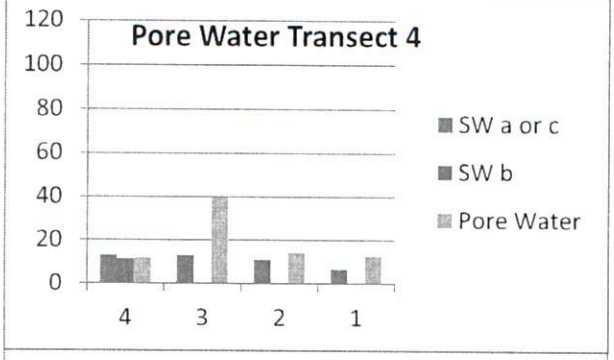
Location 4 – furthest west

Location 1 – furthest east (next to shore)









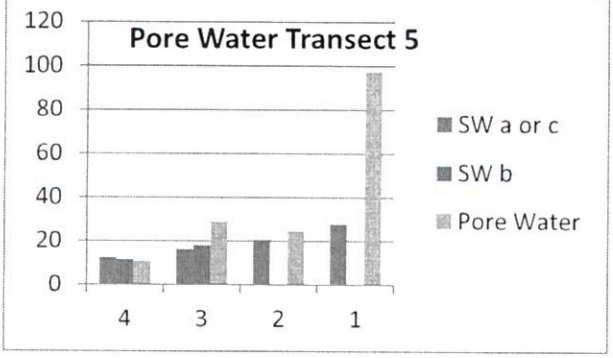


Figure F-5

Pore Water Transects – PFHS Results

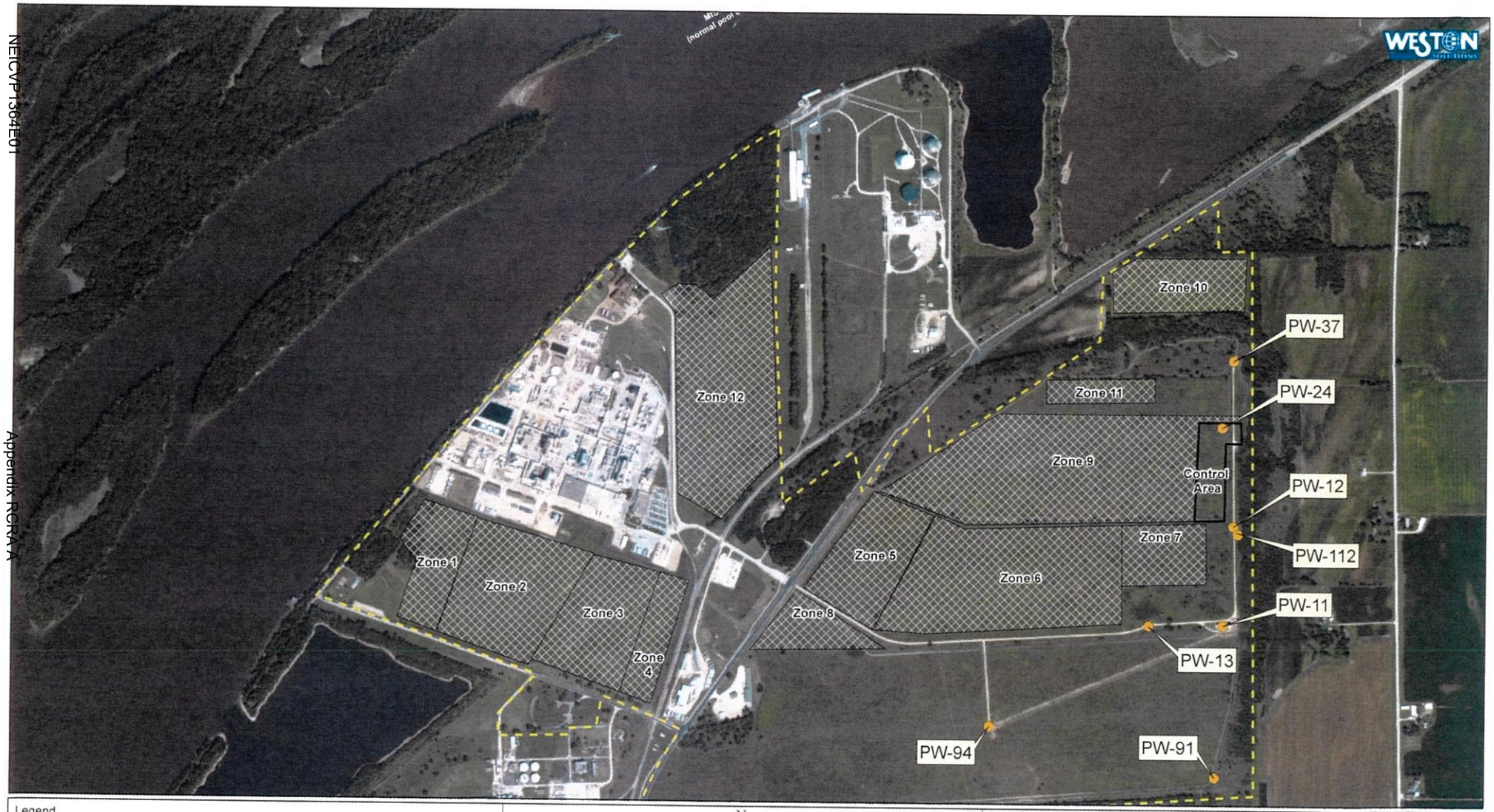
All results in ng/L (ppt)

SW – surface water

a, b, c – different sampling depths

Location 4 – furthest west

Location 1 – furthest east (next to shore)



Legend

- survey_locations
- Production Well Location
- Fomer Sludge Incorporation Area Zones
- Site Boundary

N
W E
S

0 850 1,700
Feet

Imagery Source: ESRI, DigitalGlobe, GeoEye Mapping Service.

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Figure 3
Former Sludge Incorporation Zones
and Production Well Locations
3M Cordova Facility
Cordova, IL

Legend

- Monitor Wells (Sampled in March 2008 and December 2009)
- Monitor Wells (Additional wells to be sampled)
- Production Wells
- Proposed Piezometer (Approx. locations)
- Former Sludge Incorporation Area Zones
- Site Boundary

N
W E
S

0 850 1,700
Feet

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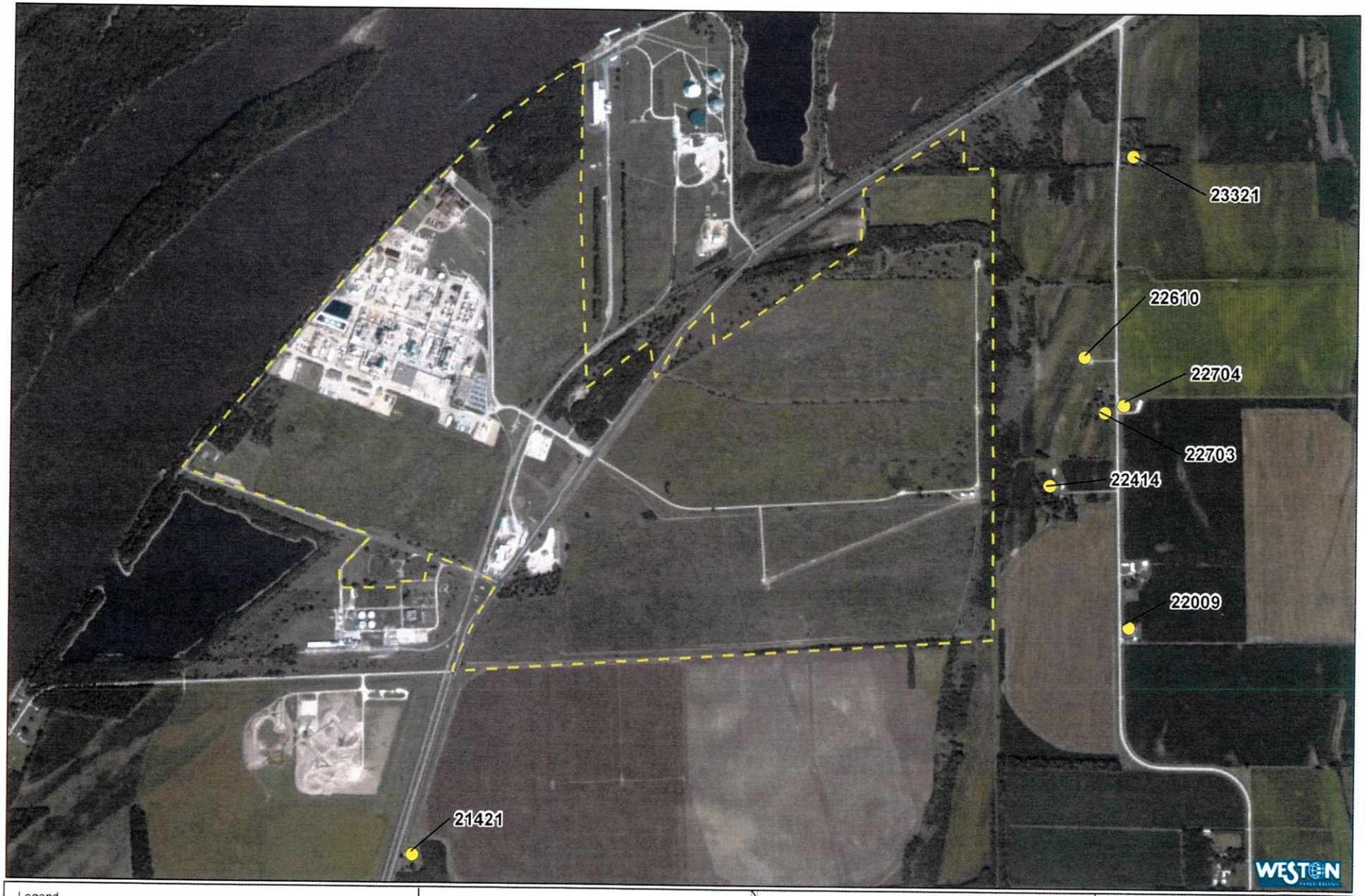
Figure 4
Groundwater Monitoring Locations
New Piezometer Locations
3M Cordova Facility
Cordova, IL



Legend

Site Boundary

Residential Wells

N
W E
S

0 1,400

Feet

Imagery Source: ESRI, DigitalGlobe, GeoEye Mapping Service.

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Figure 5

Residential Well
Sampling Locations
3M Cordova Facility
Cordova, IL

Legend

- Sampled Wells
- Production Wells
- Off-Site Wells
- Site Boundary

Note: Average sample concentrations are in ng/mL, ppb

N
W E
S

0 1,000 2,000
Feet

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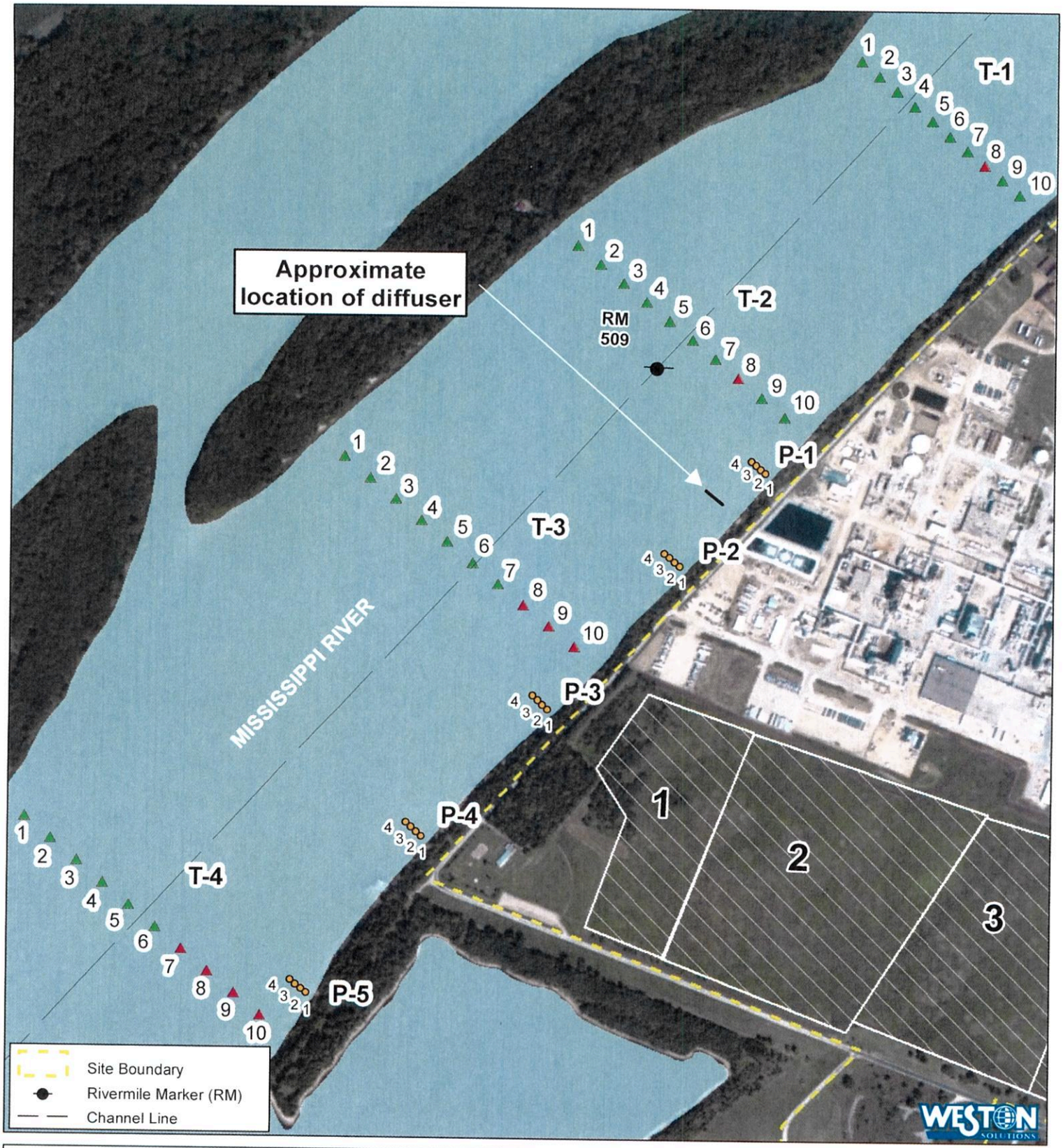
Figure 6
Groundwater Sampling Locations
3M Cordova Facility
Cordova, IL

Figure 7
Soil Boring Locations
March 2011, April/May 2012 and April 2013
3M Cordova Facility
Cordova, IL



Legend

- Surface Water Sampling Transect Locations (August 2013)
- Additional Surface Water Sampling Locations (Resampled November 2013)
- Co-Located Surface Water/Pore Water Sampling Locations (November 2013)
- Former Sludge Incorporation Area Zones

N
W E
S

0 600 1,200
Feet

Imagery Source: ESRI, DigitalGlobe, GeoEye Mapping Service.

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Figure 8
Surface Water/Pore Water Sample Locations
3M Cordova Facility
Cordova, IL

Legend

T1 Surface Water Transects (August 2013)

T5 Downstream SurfaceWater Transects (November 2013)

0 2,500 5,000 7,500

Feet

Figure 9
Downstream Surface Water Transects
November 2013
3M Cordova Facility
Cordova, IL

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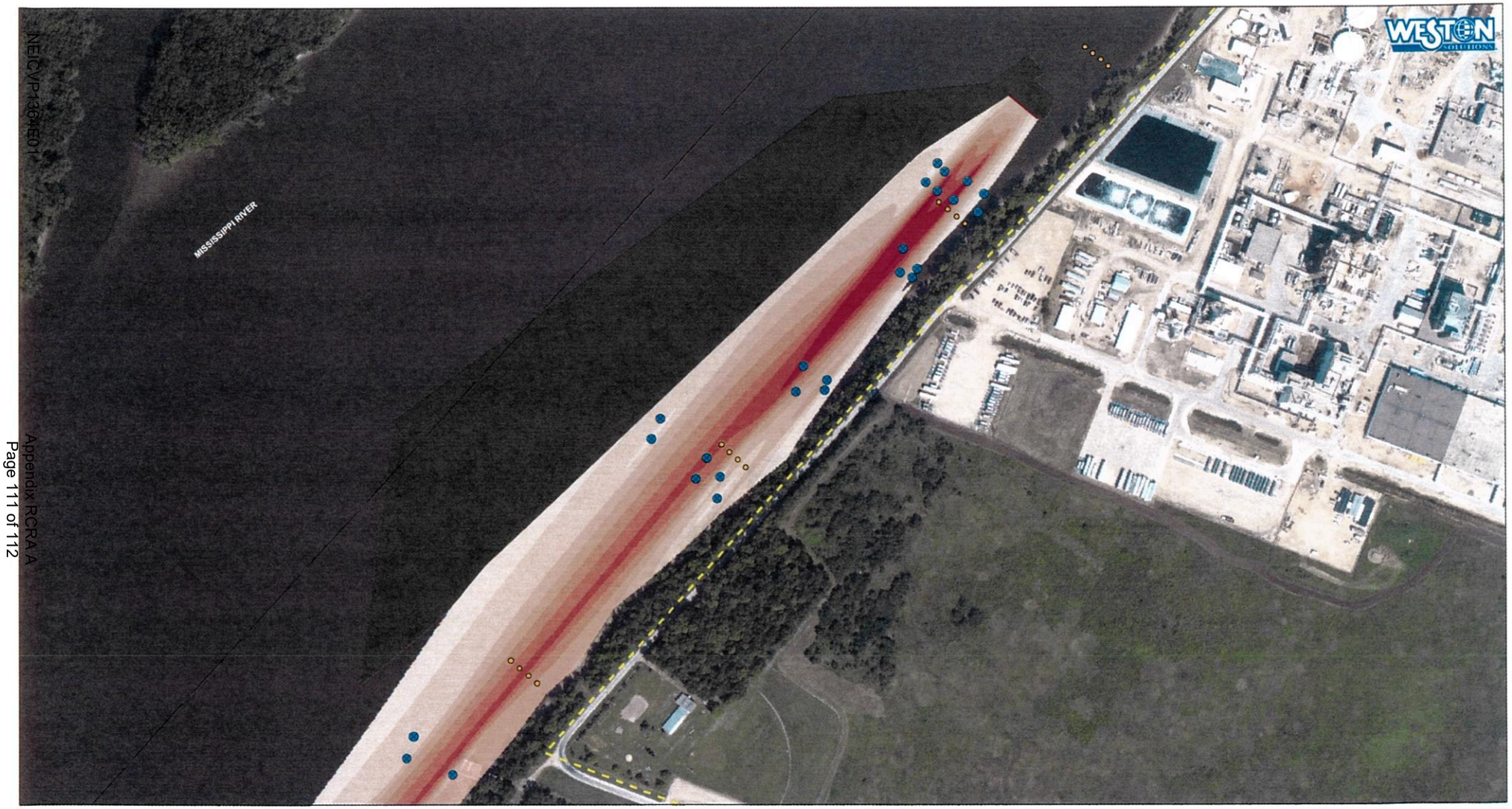

Legend

- Co-Located Surface Water/Pore Water Sampling Locations (November 2013)
- Channel Line
- Surface Water Locations
- Diffuser
- Site Boundary

Plume Concentration (Adjusted) in ppb

0.01 - 0.2	0.61 - 0.8	1.21 - 1.4
0.21 - 0.4	0.81 - 1	1.41 - 1.6
0.41 - 0.6	1.01 - 1.2	1.61 - 1.8

Notes:
-Adjusted Rhodamine WT dye concentration (ppb) = Total fluorescence Background fluorescence.
-Background fluorescence of 7.13 ppb (as Rhodamine WT).

N W E S

0 250 500
Feet

Imagery Source: ESRI, DigitalGlobe, GeoEye Mapping Service.

File: Y:\Cordova\MXD\SW_Fluorometry.mxd 2/25/2014 11:28:55 AM johnja

Figure 10
Surface Water Fluorometry
Plume Modeling
3M Cordova Facility
Cordova, IL